

Common Rail Diesel

System Diagnosis and Servicing



THIS REFERENCE MANUAL FEATURES VALUABLE TECHNICAL INFORMATION ON:

- Common Rail Diesel (CRD) Systems, Controls and Operation
- Safety Issues with Diesel Fuel and CRD Systems
- CRD Servicing Issues
- Diesel Pollution Control Issues
- Diesel Diagnosis

SPECIFIC MANUFACTURERS' SYSTEMS:

- FORD – Focus, Ranger
- HOLDEN – Captiva
- MAZDA – TB 50
- MITSUBISHI – Pajero
- NISSAN – Patrol, Pathfinder, Navara
- TOYOTA – Hilux, Prado

COMMON RAIL DIESEL SYSTEMS

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COMMON RAIL DIESEL SYSTEMS

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INTRODUCTION

In the global automotive market, all manufacturers are working hard at meeting that next emission level target, whilst improving fuel efficiency, reducing engine sizes, minimising carbon dioxide emissions and reducing manufacturing costs.

Adding to this is the recent "petrol shock" experienced in all states of the Australian market, Diesel is here to stay.

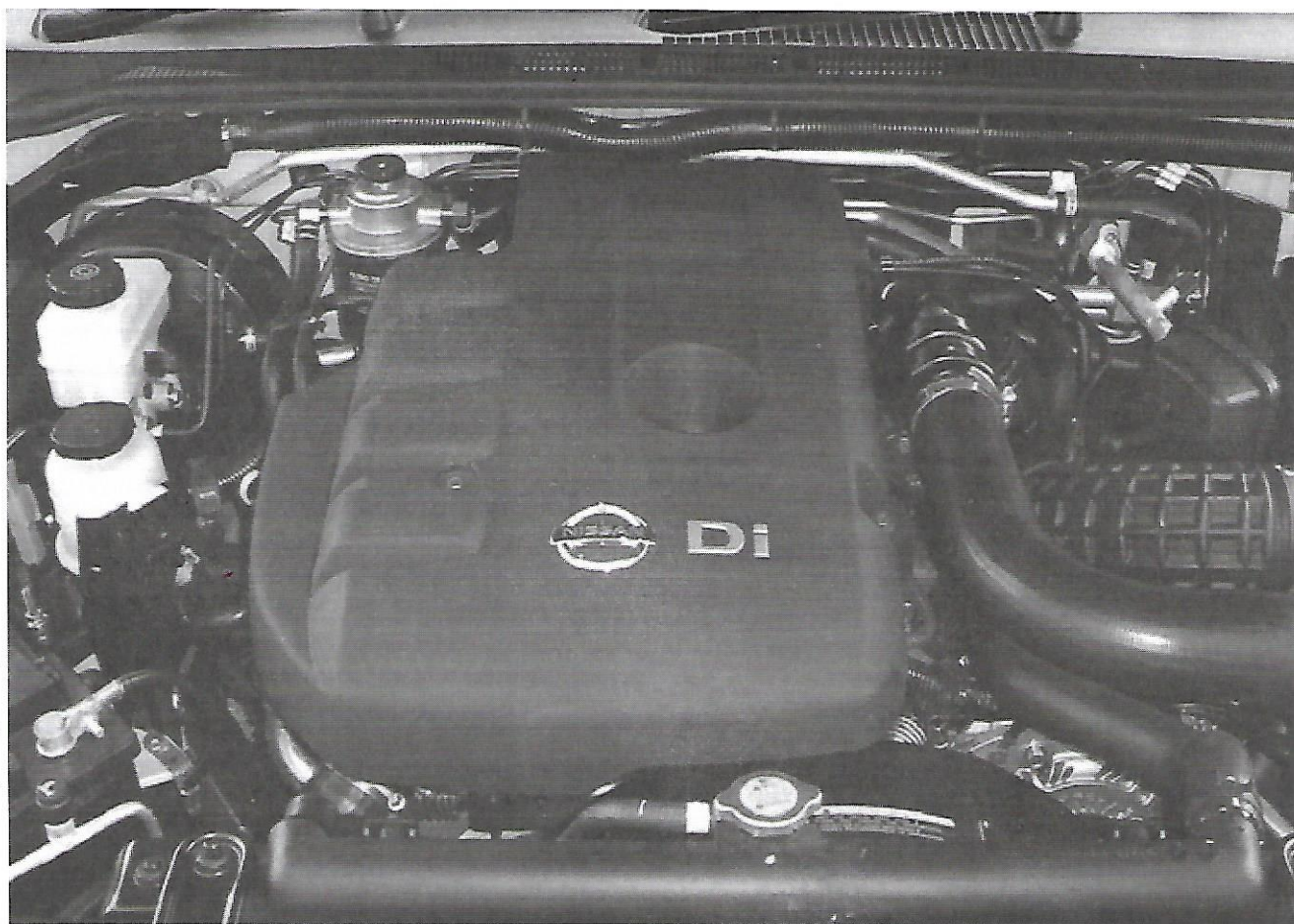
The availability of European market vehicles means an ever increasing source of Diesel powered vehicles for the Australian new vehicle market. In Europe, over 50% of the new vehicles sold each year are diesel powered. Vehicles for these markets particularly carry the latest technology and we will see these as they are brought into the Australian market.

The most "common" innovation regularly seen on Diesel engines is the use of the Common Rail Fuel Injection system.

Future of Diesel

Strong thinking suggesting that it is more efficient and money better spend than on hybrids, simply means that the new diesel systems will continue to be part of Australia's automotive future.

Diesel is more thermally efficient than current level of petrol engines, but the gap will probably narrow as the adoption of direct (into the cylinder) petrol injection becomes more widespread.



This Reference Manual will explore:

- Safety – working with diesel systems, diesel fuel, high pressures and high voltage
- The operation of Common Rail Systems (CRD)
- CRD systems components
- Pollution Control, bio-fuels, sulphur, exhaust systems and their operation
- Servicing issues and guidelines, filters, oil
- Retrofitting – exhaust gas filtering systems, the future?
- Diagnosis of Common Rail Diesel
- Manufacturers specific systems

SAFETY

It is everyone's responsibility to ensure, as far as practicable, that their workplace is kept free from risks to health and safety. The extent of that responsibility depends on the amount of control they have over a particular activity or work area in the normal course of their duties. Where more than one person has control, they have joint responsibility and each must meet their obligations to the fullest extent possible.

Duty of Care of Employers

All employers must provide and maintain a working environment that is safe and without risk to the health or safety of the workers at the workplace. Employers must also ensure that the health and safety of any other person is not adversely affected by the work. Some of the things employers must do in complying with this requirement are:

- Providing and maintaining plant so that it is safe
- Developing, implementing and maintaining safe system
- Ensuring the safe use, handling, storage and transporting of dangerous goods and hazardous substances
- Maintaining workplaces under their control and management in a condition that is safe and
- Ensuring visitors to a workplace under his control and management are aware of the safety requirements.

Duty of Care of Workers

Worker's must take appropriate care for their own health and safety and for the health and safety of all persons who may be affected by their acts at the workplace. A worker must also follow all reasonable directions given to them by their employer or their employer's representative in relation to their own and any other person's health and safety. A worker must also use relevant safety equipment when provided or made available for their use.

Workers must not:

- Willfully or recklessly interfere with or misuse anything provided in the interests of health and safety, or
- Willfully place at risk the health or safety of a person at the worker's workplace.

Safety Precautions With Diesel

Skin and eyes can be injured by diesel fuel. Prolonged exposure of skin to diesel fuel can result in dermatitis. For this reason it is advisable to wear protective non-absorbent gloves when handling fuel system components, or at least to protect hands and wrists with barrier cream.

Injector testing can be dangerous as the pressure at which atomized fuel emerges from the injector nozzles is sufficient for the fuel to penetrate skin and enter the bloodstream - which can be FATAL. Injector testing should ideally be carried out with the injector housed in an inspection booth so that the spray cannot harm anyone.

Used engine oil is carcinogenic: it can cause skin cancer. Used oil from a diesel engine is many times more carcinogenic than that from a petrol engine due to the chemical nature of the by-products of combustion. Great care must therefore be taken to protect the skin in the manner suggested in the previous paragraphs and to work cleanly when carrying out oil and filter changes.

Diesel fuel can have a detrimental effect on rubber components such as hoses and drive belts. For this reason make sure that any fuel leaks or spillages are attended to promptly.

Many other safety related warnings have been around for a long time, think before you do, use common sense.

High Voltages and High Current Draw

Many of the new electronically controlled diesel engines have various amounts of High Voltage and Current within their systems. It is essential that all technicians be aware of this and check for any warnings in the engine compartment, driver's hand book or other specification publications, before starting any electrical testing or probing.

Warning!!

*The Injectors operate with High Voltages
Ensure ignition switch is OFF before removing connectors*

Particulate Matter (PM) Emissions

Particulates or soot particles are the most visible of the pollutants emitted from the exhaust of a diesel engine. They consist of large carbon particles with other attached and absorbed chemicals.

Particulates in addition to being visible are toxic and carcinogenic. The smaller particles of less than between 2.5 to 10 microns can readily penetrate deep into the lungs causing respiratory problems.

The average human hair is around 70 microns thick. This makes some of the smaller particles about 30 times thicker than the smaller particles.

The fine particles in diesel exhausts (known as particulate matter) can penetrate deep into the lungs and pose serious health risks including aggravated asthma, lung damage and other serious health problems. In addition to this, diesel exhaust is a likely human carcinogen

Warning!!

Common Rail systems produce EXTREMELY HIGH FUEL PRESSURES, up to 200 MPa (30,000 psi).

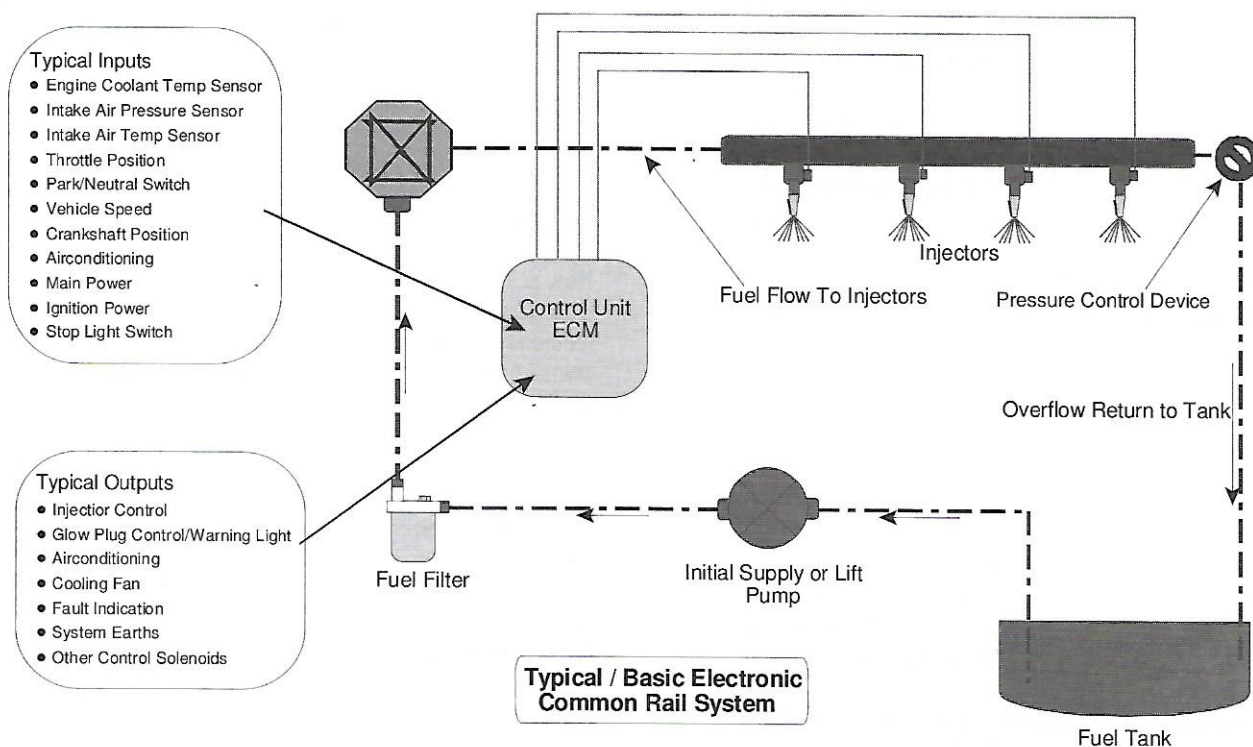
*Fuel injector pipes must not be loosened
while the engine is running.*

Bleeding of the high pressure pipes is not required.

What is a Common Rail Diesel (CRD) System ?

In a move that can be likened to the petrol engine moving from carburettors to electronic fuel injection, Diesel engines are radically changing from what was fundamentally a mechanical fuel injection system with some electronic control, to a full electronically controlled Common Rail fuel injection system.

Common Rail Diesel Fuel Injection is the modern variation of Direct Injection systems for diesel engines. The main feature is a high-pressure fuel pump and rail (sometimes in excess of 1800 bar, 26,000 psi, 180,000 kpa) feeding individual injectors with electronically controlled solenoid valves, the pressure in the Common Rail supply is the manufacturers' pressure required for Injection.



The most common misconceptions for "Common Rail" are:

- A low-pressure fuel pump feeding injector nozzles with a common supply
- A high-pressure (eg 300 psi) fuel line with a common supply to mechanical injectors controlled by cams on the camshaft
- A high-pressure fuel line (eg 300 psi) with a common supply to mechanical injectors with electronic solenoids
- A high-pressure fuel line (eg 300 psi) with a common supply to mechanical injectors with hydraulic oil control and electronic solenoids.

These are known as Unit Injector Systems where the injector produces and controls the injection pressure.

Benefits of CRD are:

- Extremely **high** injection pressures – finer spray improving atomisation and vaporisation
- Injection **pressure** control – pressure is optimised to match actual engine needs
- Injection **timing** control – accurate and variable electronic control
- Injection **rate** control – pre, main and post injection reduces delay period and emissions
- Injection **quantity** control – correction for each individual cylinder.

These benefits come from the ability to separate the **generation** of extremely high fuel pressures from the **electronic control** of fuel injection and other engine management functions.

Warning!

Common Rail systems produce **EXTREMELY HIGH FUEL PRESSURES**, up to 200 MPa (30,000 psi).

Fuel injector pipes must not be loosened while the engine is running.

Bleeding of the high pressure pipes is not required.

Warning!!

The Injectors operate with High Voltages
Ensure ignition switch is OFF before removing connectors.

Some History

The common rail system prototype was developed in the late 1960s by Robert Huber of Switzerland. The Swiss Federal Institute of Technology developed the common rail technology further.

In the mid-nineties, Dr. Shohei Itoh and Masahiko Miyaki, of the Denso Corporation, developed the Common Rail Fuel System for Heavy Duty Vehicles, its first practical use on their ECD-U2 Common Rail system, which was mounted on the Hino Raising Ranger truck in 1995.

The modern ECM controlled common rail system using the same principle, is controlled by an electronic control unit which opens each injector electronically, rather than mechanically. This was tested in the 1990s, with collaboration between Magneti Marelli, Centro Ricerche Fiat and Elasis.

After research and development by the Fiat Group, the design was acquired by the German company Robert Bosch GmbH for

further development and making suitable for mass-production. In 1997 they extended its use for passenger cars. The first passenger car that used the common rail system was the 1997 model Alfa Romeo 156 1.9 JTD and later on that same year Mercedes-Benz E 320 CDI.

Common rail engines have been used in marine and locomotive applications for some time.

The engines are suitable for all types of road cars with diesel engines, ranging from city cars to large family cars.

Common Rail today

Today the common rail system has brought about a revolution in diesel engine technology. Robert Bosch GmbH, Delphi Automotive Systems, Denso Corporation and Siemens VDO are the main suppliers of modern common rail systems.

Diesel Fuel and Emissions

Australian Diesel Fuel

Status of diesel fuel quality in Australia has improved and continues to be monitored and improved by the oil companies in accordance with current and ongoing legislation. Some companies being ahead of the requirements and deadlines.

Currently in Australia the requirement is 50 ppm reducing to 10 ppm in 2009, this came from 500 ppm (since 2002)

This ensures that Australia has diesel fuel of a quality consistent with international standards and will enable the import of latest technology low emission and high economy diesel engines from Europe and the United States.

Sulphur levels have diminished over the years from as high as 500 ppm to a low requirement by 2009 of 10ppm. This level of sulphur creates other problems with today's fuel for many of the older versions of diesel engines.

Lubricity Problems

Sulphur compounds in diesel fuel are a natural lubricant for fuel system components. Lowering the sulphur reduces the natural lubricity of the fuel. To ensure the lubrication quality of fuel, the fuel is constantly tested and if required additives are used during the manufacturing process to meet acceptable international levels.

Some equipment / vehicle engines that are approx. 6-8 years old with rotary and AV type pumps may notice some levels of leakage of fuel around the fuel pump body and other components.

Most of these early components including hoses, seals and gaskets have been made from a rubber compound of some description, nitrile, NBR etc..

Warning!!

Later fuel systems are now using a product called Viton, if this compound is put through a fire, it is not to be touched by bare skin. During the fire process Viton goes through a chemical change and acts like an acid. This can cause severe burns.

Biodiesel

Biodiesel is produced from vegetable oils or animal fats and used as a substitute for conventional diesel.

How is Biodiesel Manufactured?

During a process called transesterification, a catalyst and methanol are used to create a chemical reaction that converts animal or vegetable fats into biodiesel. This pure biodiesel (B100) is blended with regular diesel to create a biodiesel blend. A mixture of 5 per cent biodiesel and 95 per cent diesel, is commonly referred to as 'B5'.

In Australia, biodiesel is often made from domestically produced tallow, but can also be made from domestic and/or imported vegetable oils such as canola or sunflower oil, or imported palm oil.

Biodiesel blends can work as well as conventional diesel. However, biodiesel can have different properties that have not been fully tested and accepted by most manufacturers, these properties can affect its performance in different ways.

Biodiesel made from high saturated fats tend to become thick or even solidify at temperatures below 10°C, making them unsuitable for use in colder conditions. Conversely, while biodiesel derived from unsaturated fats like canola oil has less problems at low temperatures, it is also less stable to heat and oxygen, which can lead to filter blocking in engines.

So whether or not you can use biodiesel blends depends on a combination of factors, the percentage of biodiesel within the blend, the type of engine and the operating conditions in which it will be used.

We recommend you check with the vehicle manufacturer for all guide lines and requirements relating to the use of Biodiesel, particularly if the vehicle is still under any warranty.

If you use biodiesel blends, the biodiesel component (B100) should comply with the Australian Biodiesel Standard. In some cases, it may also be important that the blended product (e.g. B5) complies with the Australian Diesel Standard.

Also note that biodiesel blends also contain oxygen, meaning they have a lower energy content than conventional hydrocarbon diesel, which may cause slight power loss depending on the blend.

Renewable Diesel Fuel

There are some companies constantly testing a new diesel fuel that will create zero emissions, this is generally known as Renewable Diesel Fuel.

It differs from Biodiesel only in the way it is manufactured. Biodiesel is a blend of diesel and plant or animal additives after the diesel has been refined.

Renewable diesel is a combination of crude diesel, plant or animal additives then processed or refined. BP has a factory / refinery in Queensland producing this fuel.

Particulate Matter (PM) Emissions

Particulates or soot particles are the most visible of the pollutants emitted from the exhaust of a diesel engine. They consist of large carbon particles with other attached and absorbed chemicals.

Particulates in addition to being visible are toxic and carcinogenic. The smaller particles of less than between 2.5 to 10 microns can readily penetrate deep into the lungs causing respiratory problems.

The average human hair is around 70 microns thick. This makes some of the smaller particles. About 30 times thicker than the smaller particles..

The fine particles in diesel exhausts (known as particulate matter) can penetrate deep into the lungs and pose serious health risks including aggravated asthma, lung damage and other serious health problems. In addition to this, diesel exhaust is a likely human carcinogenic.

Some air quality experts suggest that the finer particles emitted from vehicles with Diesel Particulate Filters are actually a greater risk to health. They can dissolve in the lungs and travel further than the previously larger particles.

Diesel exhausts also have environmental impacts. Particulate matter from Diesel engines contributes to haze, ozone formation (a component of smog), acid rain and global climate change. Currently, diesel Particulate Filters, along with other internal engine changes are commonly used to reduce PM by nearly 100%

Oxides of Nitrogen (NO_x) Emissions

Emissions of NO_x are the next big problem.

More complex EGR systems are being used to minimise NO_x Australian Design Rule (ADR) 80/02 – Emission Control for Heavy Vehicles, (which equates to Euro 4) applies to all new vehicles sold from January 2008. This ADR required a reduction in NO_x by 30% and Particulate Matter by 80%.

ADR 80/03 – Emission Control for Heavy Vehicles, (which equates to Euro 5) applies to all new model vehicles from January 2010 and all vehicles sold from January 2011. This ADR will require further 40% reduction in NO_x, but no further reductions in Particulate Matter.

Standard	Application Date	NO _x Emission Limit (g/kWh)
ADR 80/00	2002/2003	5.0
ADR 80/01	2007/2008	3.5
ADR 80/02	2010/2011	2.0

EGR System Example

The Exhaust Gas Recirculation System incorporates:

- EGR Valve (With Servo Motor).
- EGR Valve Servo Motor.
- EGR Valve Sensor.
- EGR Cooler.
- Electronic Throttle Control.

It enables circulation of a portion of exhaust gases back into the intake manifold. This reduces combustion temperature and exhaust emissions. During EGR operation additional engine vacuum may be required. This vacuum is provided by ECM operation of the electronic throttle valve.

EGR Valve

The Exhaust Gas Recirculation Valve is located on top of the main air inlet tube. This Valve is used to recirculate a portion of exhaust gas back into the intake manifold.

The ECM controls this Valve using the EGR Valve Servo Motor.

EGR Valve Sensor

The hall element Exhaust Gas Recirculation Valve Sensor is located on the end the EGR Valve. It is used by the ECM to monitor the EGR Valve position.

This Sensor provides feedback for the EGR System The Exhaust Gas Recirculation Valve Servo Motor is located with the EGR Valve. It is part of the Exhaust Gas Recirculation System. The ECM drives this Servo to move the EGR Valve to the desired position.

EGR Cooler

The EGR Cooler is located above the exhaust manifold.

It is used to by the EGR System to cool the exhaust gas prior to recirculation.

Common Rail Diesel Technology

Common Rail Diesel (CRD) Fuel Injection Systems

In a move that can be likened to the petrol engine moving from carburetors to electronic fuel injection. Diesel engines are radically changing from what was fundamentally a mechanical fuel injection system with some electronic control, to a full electronically controlled Common Rail fuel injection system. Forget the old indirect injection systems, with common rail and the high pressures available, it all happens directly into the combustion chamber.

Injecting fuel anywhere else is a heat and therefore an energy loss.

Benefits of CRD are:

- Extremely **high** injection pressures – finer spray improving atomisation and vapourisation

- Injection **pressure** control – pressure is optimised to match actual engine needs
- Injection **timing** control – accurate and variable electronic control
- Injection **rate** control – pre, main and post injection reduces delay period and emissions
- Injection **quantity** control – correction for each individual cylinder.

These benefits come from the ability to separate the **generation** of extremely high fuel pressures from the **electronic control** of fuel injection and other engine management functions.

Phases of combustion

To understand some of the benefits of CRD, we need to look closely at the Diesel combustion process. Until now, the four phases of Diesel combustion have not fundamentally changed since the inception of the Diesel engine. The phases are:

- Delay Period
- Uncontrolled Burning
- Controlled Burning
- After Burning

Delay Period

This is the period of time taken from when the first fuel is injected to when it actually begins to burn. With CRD, this is drastically minimised by employing a pre or pilot injection of highly pressurised and atomised fuel. The small pilot injection takes little heat from the combustion chamber to begin burning and so commences relatively soon after it has been injected. It can be likened to using kindling instead of a log to start a fire.

Uncontrolled Burning

This is caused by the accumulation of fuel that was injected during the delay period when it finally ignites. Since there is more fuel in the cylinder than can be efficiently converted into mechanical energy, the result is very high combustion pressures AND noise (Diesel knock) as it takes off burning rapidly.

As well as the characteristic Diesel knock, this situation creates high emissions of NOX.

With CRD, the pilot injection begins the fire and heats the combustion chamber so that when the main injection occurs, it burns more readily, minimising peak combustion pressures and temperatures. In this way, fuel is more readily converted into mechanical energy.

Controlled Burning

This is when the fuel burns at the rate it is injected at. The rate of combustion is now controlled externally to the cylinder. It is this controlled burning over a greater crankshaft angle that gives a Diesel engine a greater thermal efficiency than a petrol engine. Compared to a petrol engine, the Diesel has more of a constant pressure power stroke, providing greater torque. With CRD, more of the fuel is consumed in this period and so efficiency is increased.

After Burning

This is where the remnants of injected fuel burn (usually incompletely) without adding anything to the conversion to mechanical energy; basically wasted fuel creating emissions. With CRD, this can be controlled with a post injection to minimise emissions and control the regeneration process of a Diesel Particulate Filter (If Fitted).

Overview of Common Rail Systems

Main components

- Pump
- Injectors
- Pipes
- Rail
- ECM & key sensors

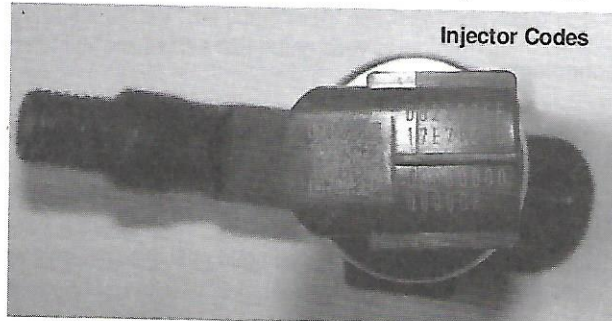
Piezo Fuel Injectors

The Fuel Injectors are located in the cylinder head and usually protrude through the rocker cover. They are operated sequentially using multiple injections by the ECM. If an injector requires replacement, a Fuel Injector Calibration Code procedure will in most engines be required

Warning!

The Injectors may operate up to 100 Volts approx.

- Ensure ignition switch is OFF before removing connectors.



Fuel Injector Calibration Code

The Calibration Code is a unique digit / alphanumeric value, printed on the head of each injector. If an injector is replaced, ECM programming functions are required for this new injector.

These include:

- Fuel Injector Calibration Code writing (using new injector code).
- Fuel Injection Idle Quantity learnt value.

The manufacturers Scan Tool will be necessary for these functions. If any of these programming functions are not completed correctly:

- Engine noise / rattle may be evident.
- Engine idle may become rough.
- Deterioration occurs in emission levels and engine operation.
- Fault Codes may be stored in the ECM.

Note!

If the ECM is replaced, all existing fuel injector Calibration Codes must be written to the new ECM

Fuel Injector Pipes/ Rails and Rail Sensors and Fittings

The high pressure Fuel Injector Pipes are generally recommended to be replaced if any pipe, rail, sensor or fitting is removed and any sealing is interrupted or broken. Some manufacturers eg. Mitsubishi, recommend they are able to be re-used up to 5 times. This is provided the same common rail injection components are re-used. If unable to verify the number of times used, then replace the Fuel Injector Pipes.

Warning!

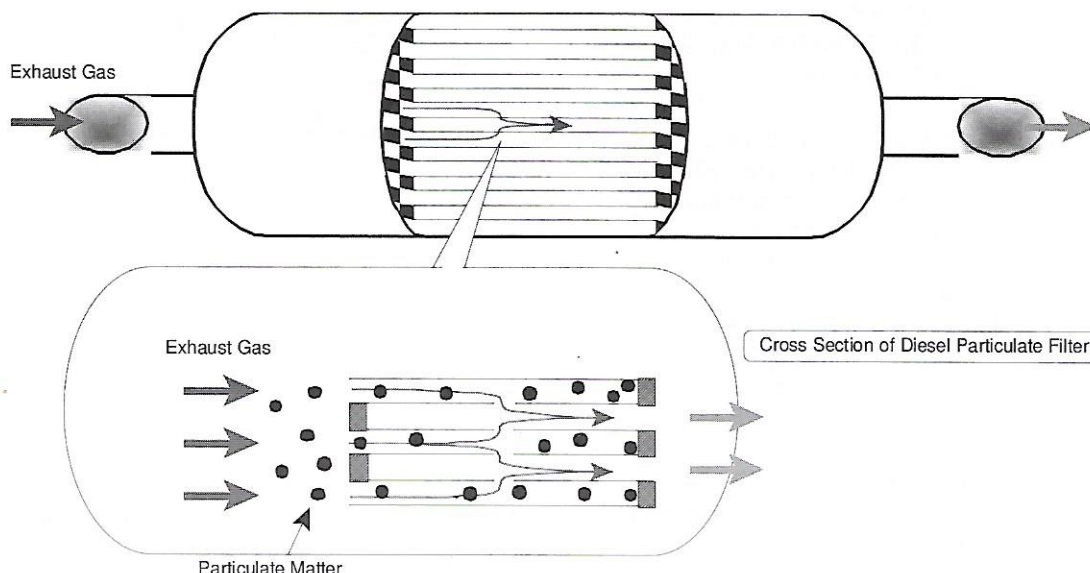
Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.

Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes. On most common rail injection engines, the high pressure fuel injector pipes are designed for single use only. If they are loosened for any reason, they must be replaced.

Particulate Matter (PM)

Along with potentially high levels of NOX, the other obvious vice of the Diesel engine is the emission of Particulate Matter (PM). Particulates or soot particles are the most visible of the pollutants emitted from the exhaust of a diesel engine. They consist of large carbon particles with other attached and absorbed chemicals. These solid emissions can be effectively reduced by filtration of the exhaust.

microporous walls. The core has alternate channels plugged which forces the gas to flow through the wall and the particulates collect in the channel's "dead end". Some DPF systems use a replaceable filter element.



DPF Operation

A DPF cleans the exhaust gas by forcing it to flow through the filter which collects the PM carried by the exhaust stream. The solid particles are trapped and the gasses escape through the wall, which is directed to the exhaust outlet.

The collected soot builds up within the filter, which will clog and eventually block resulting in a build up of engine back pressure unless it is removed. The removal is achieved by a regular process known as Regeneration.

Diesel Particulate Filter (DPF)

Diesel Particulate Filters are emerging as a common method to meet Euro IV emissions on vehicles built for the European markets. They have been used on road vehicles in some parts of the world since 1996. They look a lot like a catalyst, but are in fact more. We will be seeing more of these, particularly in the phase between Euro IV and Euro V compliant vehicles. Carmakers estimate that DPF's remove between 85% and 100% of PM.

Renault say they reduce PM to below the measurable threshold of 5 mg per k (Euro 4 is 25 mg / k)

If the engine is in good condition and driving patterns are "normal", then the operation of the DPF will be invisible to the vehicle driver and it may last the life of the vehicle. However, as engines age, incorrect oil and fuel are used and driving patterns change (short runs), problems will emerge that may require:

- A particular drive cycle
- Conducting a Service Regeneration
- DPF replacement.

DPF Construction

The DPF core looks similar to a catalytic converter. It is made from a ceramic substrate; usually silicone carbide which has

Oxidation Catalyst

An Oxidation Catalyst is usually positioned up stream from the DPF to assist in the regeneration process. A Diesel operates in an excess air environment and the exhaust gases can contain around 15% oxygen.

Regeneration

Regeneration is the process of removing accumulated particles from the filter. Regeneration occurs automatically given the right driving conditions. If necessary, it can be performed on demand (Service Regeneration) using the factory scan tool.

Active management of the engine management system is used to increase exhaust temperature combined with an oxidation catalyst. Extra fuel is added to the exhaust system during the exhaust stroke by a "post injection". This is used to assist in raising the exhaust temperature.

The high temperature of the exhaust heats the ceramic structure and allows the particles inside to break down (oxidise) into less harmful components. The trapped PM is burned through a catalytic reaction using exhaust gas heated to approximately 660°C to 800°C.

ECM Active Management

The ECM estimates the amount of PM in the DPF based on the distance travelled and the differential exhaust pressure (amount of blockage). Just prior to regeneration, the DPF will be partially blocked a predetermined amount. This is measured by the upstream and downstream exhaust pressure sensors.

The ECM automatically performs regeneration when the amount of PM in the DPF reaches the specified level. This occurs every so often in a range that may vary from every 200 to 1,000 kilometres, depending on the make of vehicle and driving conditions. The shorter the running, the more often the regeneration will occur. To perform regeneration, the ECM raises the temperature of the exhaust gas to activate the Oxidation Catalyst.

The ECM does this by:

- Partially closing the electronic throttle to reduce air volume
- Retarding the fuel injection timing
- Injects additional fuel during the exhaust stroke (post injection)
- Varies the EGR operation.

Note!

Diesel engines are not controlled by a throttle like a petrol engine is. The diesel throttle valve is there for the DPF Regeneration and Idle Cut Off functions.

During the regeneration, the ECM performs feedback control to keep emission levels low and burn the PM safely and efficiently. This feedback control is based on the air fuel mixture ratio and exhaust gas inlet and outlet temperatures.

Note!

Use of incorrect oil specification will eventually coat the Oxidation Catalyst and the DPF, reducing their service life.
FOLLOW MANUFACTURERS OIL RECOMMENDATIONS CLOSELY.

Fuel Assisted Regeneration System

To improve the regeneration process efficiency during low load and low speed vehicle operation, some vehicles use an additional injector to spray fuel into the exhaust ahead of the DPF to generate sufficient heat. A separate low pressure fuel pump, lines and fuel filter supplies this injector.

An advantage of this system is that if a Service Regeneration is conducted, the engine oil is not diluted and does not require changing.

Note!

There may be some odour noticed during the regeneration

Aftermarket DPF Fitment

Some congested cities of the world (Tokyo, Mexico City, Hong Kong and London) require or encourage retrofit of a DPF. Generally, these are autonomous units and are not controlled or regenerated by the ECM. Reduction in PM is much lower, around 30 to 50%.

Service Regeneration

If the vehicle has been subject to short stop-start running, the DPF light is illuminated (the MIL Lamp may also be illuminated) and it won't regenerate out through normal driving, a Service Regeneration will need to be conducted. This will also need to be conducted if the ECM has been replaced as the new ECM will not know how long it has been since the last regeneration occurred.

A Service Regeneration will vary depending on the vehicle manufacturer, but they all follow a similar process:

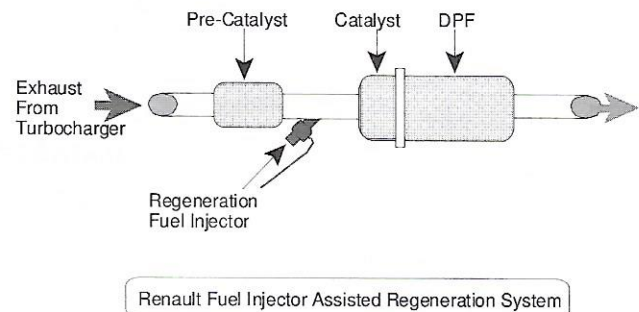
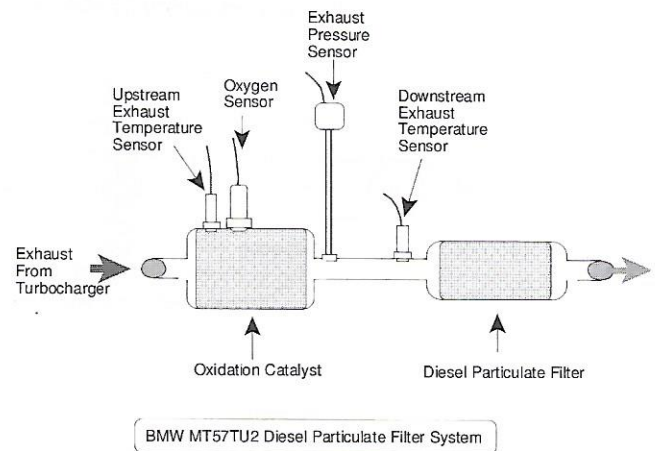
- The vehicle is prepared and set to regenerate using the appropriate scan tool (usually factory tool)
- Engine is left to run for a period of time (may be from 15 to 80 minutes, ECM may need to repeat the shorter procedure a number of times to regenerate effectively)
- The ECM goes through the regeneration process – running at around 2000 RPM

Note!

Extremely high temperatures are created during regeneration. This is best done with the vehicle outdoors on a surface not affected by excessive heat from the DPF and exhaust

Engine Oil and Filter Replacement

In most cases, the manufacturer will require the engine oil and filter to be replaced after a Service Regeneration. Some vehicles actually increase the oil pan level by around half a litre due to dilution from the addition of extra fuel injected during the Service Regeneration process.



Selective Catalytic Reduction (SCR)

One of the problems associated with Diesel engines is that in order to improve efficiency; thereby improving engine power, lowering fuel consumption and reducing emissions of Particulate Matter, the by-product of the higher combustion temperatures is an increase in the emission of oxides of nitrogen (NO_x). Whilst Exhaust Gas Recirculation has been used for many years to reduce NO_x, this method is no longer acceptable as it works against the general efficiency of an engine and every loss must be recouped.

SCR is a relatively simple and low cost technology to reduce NO_x in the exhaust pipe. It can yield reductions of up to 90%. The concept of SCR was patented in 1957 and has been developed and used in many industrial applications like stationary power plants and more recently ships, locomotives and motor vehicles.

Using SCR the engine can be optimised for higher power output, low particulate matter emissions and low fuel consumption. The reduction of NO_x is handled by after treatment in the exhaust pipe via the SCR catalyst.

Most European truck makers are using SCR technology to meet Euro 4 and Euro 5 exhaust emission requirements. These same vehicles are also on the roads here in Australia. Over the next few years, the number of SCR equipped vehicles on our roads is expected to increase significantly.

Mercedes-Benz has been using SCR under the banner of "BLUETEC" truck engine technology.

Australian Emission Regulations

Australian Design Rule (ADR) 80/02 – Emission Control for Heavy Vehicles, (which equates to Euro 4) applies to all new vehicles sold from January 2008. This ADR required a reduction in NO_x by 30% and Particulate Matter by 80%.

ADR 80/03 – Emission Control for Heavy Vehicles, (which equates to Euro 5) applies to all new model vehicles from January 2010 and all vehicles sold from January 2011. This ADR will require further 40% reduction in NO_x, but no further reductions in Particulate Matter.

Standard	Application Date	NO _x Emission Limit (g/kWh)
ADR 80/00	2002/2003	5.0
ADR 80/01	2007/2008	3.5
ADR 80/02	2010/2011	2.0

NO_x Reducing Agent

SCR operation relies on a NO_x Reducing Agent (ammonia) which is injected into the exhaust prior to a special catalyst to transform NO_x molecules into nitrogen and water. Since ammonia is not the most suitable substance to be carrying around on vehicles, an "Aqueous Urea Solution" is used as the source of ammonia. The urea in the solution converts to ammonia when it is injected into the exhaust stream.

Aqueous Urea Solution

The Aqueous Urea Solution consists of approx. 32.5% Urea and 67.5% deionised / demineralised water. It is non toxic, non flammable, colourless, usually odourless and must be manufactured to meet the DIN 70070 standard.

One of the most common brands of urea solutions is a liquid marketed as "AdBlue". There is a growing network of AdBlue distribution around Australia. This began initially through truck dealerships and workshops and now includes tie ups with several national fuel companies.

AdBlue currently costs around \$1.15 per litre in bulk (1,000L).

AdBlue say consumption (for trucks) is in the range of:

- 4% by volume of diesel consumption for ADR 80/02 (Euro 4) vehicles.
- 6% by volume of diesel consumption for ADR 80/03 (Euro 5) vehicles.

SCR System Layout

A tank contains the urea solution. A pump draws the urea solution from the tank and delivers it to the metering unit. The electronically controlled metering unit meters the urea solution into the mixer located in the exhaust stream. The SCR Catalyst is positioned after the mixer.

SCR System Operation

The metering unit injects the urea solution into the exhaust flow prior to the SCR Catalyst.

The urea solution mixes with the exhaust gas where it is converted into ammonia.

In the SCR Catalyst, the ammonia reacts with the NO_x, converting it to nitrogen and water.

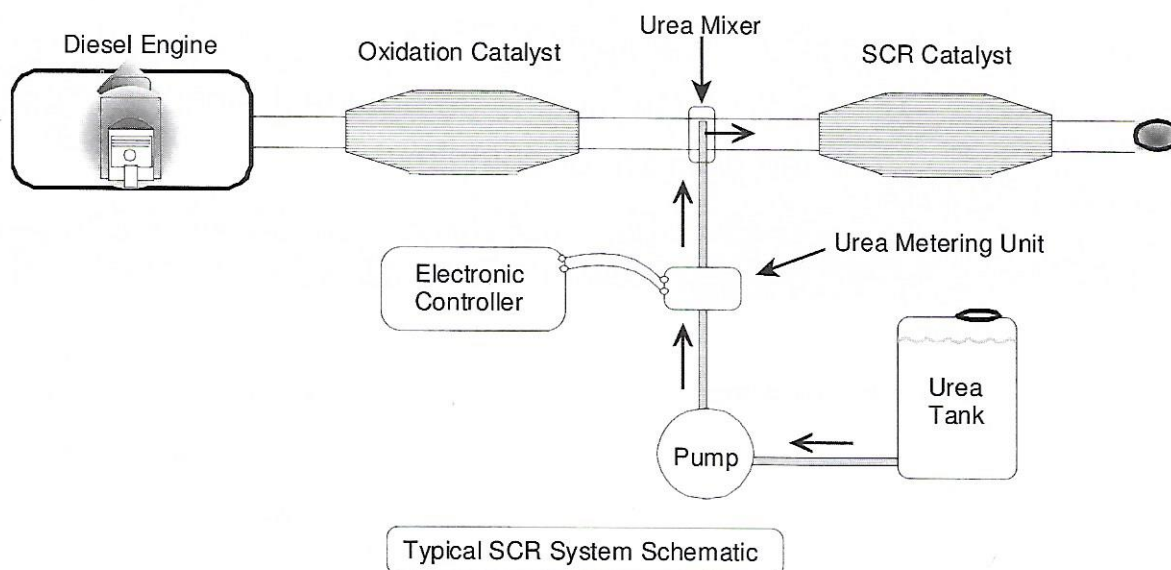
If the urea solution tank is allowed to become empty or the incorrect specification liquid is used, the on board diagnostic system will detect an increase in NO_x and will illuminate a warning lamp.

If the NO_x is allowed to increase to approx. 5g/kWh, the engine's ECU will record the data surrounding this event for later retrieval.

If the fault remains and NO_x levels increase to twice the limit (7g/kWh), the ECU apply a 40% power reduction strategy. The loss of power is enough incentive to have the vehicle condition rectified.

Mercedes-Benz has developed an AdBlue tank with a special filler neck that requires a dedicated nozzle to fill it. This ensures the tank does not get filled with diesel or petrol.

Apart from filling up the urea solution tank, there are generally no other significant servicing requirements for the SCR system. For best SCR efficiency, a low sulphur diesel fuel of less than 15 ppm is required.



Diagnosis and Servicing

Engine Oil & Filter Replacement

It is of the out most importance that the correct serving schedule is adhered to and that the correct filters and oil are used,

Note!

Use of incorrect oil specification will eventually coat the Oxidation Catalyst and the DPF, reducing their service life.

FOLLOW MANUFACTURERS OIL RECOMMENDATIONS CLOSELY.

Some manufacturers require a reset of the service light and system after an oil and filter change.

The correct oil for Common Rail Diesel Engines, to be able to work in conjunction with emission control devices and systems must be of a Low Sulphated Ash, Sulphur and Phosphorus level.

Engine Oil Classifications

International Lubricant Standardization and Approval Committee (ILSAC)

New GF-5 motor oil specification, will be the factory fill for 2010 model-year engines.

GF-5 motor oils will be the most technologically advanced motor oil, exceeding the current GF-4 category in a number of important performance areas.

ILSAC identified several major areas that automakers would like to see improved with the GF-5 category. These areas include: fuel economy and fuel economy retention throughout the oil drain; emission-control systems protection; and increased sludge, deposit and oxidation control, low-temperature viscosity, high and low-temperature corrosion, turbocharger protection and filter clogging protection.

One of the highest priorities engine oil manufacturers is making GF-5 motor oil backward compatible. Developing engine oil that is compatible for new and older engines helps prevent misapplications.

ACEA - European Automobile Manufacturers Association

A/B Oils suit most petrol and standard light diesel

A1/B1, A3/B3, A3/B4, A5/B5

These oils may be unsuitable for use in some engines. Consult owner manual or handbook if in doubt.

C Oils suit Catalyst Engines

C1, C2, C3, C4, C5

For use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines requiring low friction, low viscosity, low SAPS oils with a high HTHS. These oils will increase the DPF and TWC life and provide fuel economy benefit.

Warning!!

These oils have the lowest SAPS limits and may be unsuitable for use in some engines.

Consult owner manual or handbook if in doubt.

SAPS: Sulphated Ash, Phosphorus, Sulphur

DPF: Diesel Particulate Filter

TWC: Three way catalyst

HTHS: High temperature / High shear rate viscosity EGR: Exhaust Gas Recirculation

API - American Petroleum Institute

C4, C14

For use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines requiring low friction, low viscosity, low SAPS oils with a high HTHS. These oils will increase the DPF and TWC life and provide fuel economy benefit.

Warning!!

These oils have the lowest SAPS limits and may be unsuitable for use in some engines.

Consult owner manual or handbook if in doubt.

SAPS: Sulphated Ash, Phosphorus, Sulphur

DPF: Diesel Particulate Filter

TWC: Three way catalyst

HTHS: High temperature / High shear rate viscosity EGR: Exhaust Gas Recirculation

Diagnosis is the process of examining the symptoms of a problem or complaint and carefully analysing the facts to determine the cause or causes of the problem or complaint.

Diagnosis of Common Rail Diesel (CRD)

Diagnosing problems with CRD engines is very similar to any other diesel engine or petrol engine. There are obviously differences in the make up of operation and controls, the main approach to any problem has not changed.

The operation of a CRD, like all other engines requires three main systems to be operating correctly:

- Fuel Supply
- Mechanical Components
- Electrical control

Like all other vehicle systems, you must have product knowledge, specifications, basic skills, look for the obvious and simple solution.

Safety is absolutely paramount in working with CRD systems

Warning!!

Common Rail systems produce EXTREMELY HIGH FUEL PRESSURES, up to 200 MPa (30,000 psi).

Fuel injector pipes must not be loosened while the engine is running.

Allow some time for pressure to dissipate after turn off

Warning!!

The Injectors operate with High Voltages Can be up to 120 Volts or more with up to a 20amp current draw. Ensure ignition switch is OFF before removing connectors.

Manufacturer: MITSUBISHI

Application: PAJERO NS 2007-On
3.2L DOHC 16 VALVE (4M41 Engine)

Subject: Engine Management System
(For Models equipped with Common Rail
Direct Injection Turbo Diesel Engine)

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Overview

These vehicles are fitted with a direct injection 3.2Litre DOHC 16 Valve 4M41 Turbo Diesel Engine.

A common rail fuel injection system is used, being controlled by an Electronic Control Module (ECM). Auto models have a separate control module for automatic transmission control.

The Fuel Injectors are operated sequentially, using multi-stage injection.

Air mass calculation is by a Mass Air Flow Sensor and a Manifold Absolute Pressure Sensor. Communication between modules is via serial data on the CAN Communication Bus.

The following are all electronically controlled by the ECM:

- Glow Plug System.
- Diesel Particulate Filter System (Auto).
- Exhaust Gas Recirculation System.
- Cruise Control System.
- Fuel Injector and Fuel Pressure Operation.
- Turbocharger System with boost pressure control (Auto).
- Swirl Control System.
- Electronic Throttle Control.

Transmission:

These vehicles may be fitted with:

Five Speed Manual Gearbox – V5M31.

Five Speed Auto Trans – V5A5A.



ECM

The 2 Connector 121 Pin ECM is located behind the left side under-dash area, being mounted vertically.

The Mitsubishi MUT III Scan Tool is required for the ECM programming functions:

- Vehicle Chassis Number writing, and Key ID Code registration using Immobiliser Module data.
- Fuel Injector Calibration Code writing, and Fuel Injection Idle Quantity learnt value.

Warning!

High voltages are used to operate the Fuel Injectors. Ensure ignition is OFF before touching or disconnecting the Injector wiring.

Note!

If ECM replacement is required, the ignition key(s) need to be replaced in conjunction with it.

Fault Codes

The Fault Codes are OBDII type. They can be accessed using a compatible scan tool.

Code Types:

Active Codes are currently occurring faults.

Stored Codes are past faults recorded (these may also become Active when re-tested).

Note!

Should the Malfunction Indicator Lamp (MIL) illuminate, this may indicate a system fault.

Check ECM for the presence of Fault Codes, using an OBDII compatible scan tool.

Diagnostic Connector

The 16 Pin OBDII Diagnostic Connector is located under the right side dash, near the centre console.

These vehicles use the Controller Area Network (CAN) Bus for diagnostic communication.

Scan tools will plug into this connector for diagnosis.

Fault Code Identification

Fault Code Extraction

An OBDII compatible scan tool is required to extract Fault Codes.

Freeze Frame Data:

The ECM will store sensor and actuator data relevant to a fault, when a Fault Code is logged.

This data provides a snap-shot of the conditions causing this Fault Code to log.

An OBDII compatible scan tool can access this data.

Fault Code Erasure

An OBDII compatible scan tool is necessary to erase Fault Codes.



- 3 = SWS Low Speed Communication Circuit
- 4 = Ground Circuit
- 5 = Ground Circuit
- 6 = CAN Bus High to Engine ECM Pin #B27
- 14 = CAN Bus Low to Engine ECM Pin #B35
- 16 = Power Supply from Battery

Mitsubishi 4M41 16 Pin Diagnostic Connector

Code #	Fault
P0016	Crankshaft Position Sensor / Camshaft Position Sensor Phase Problem
P0047	Turbo Boost Control Solenoid (Auto) Circuit Malfunction (Low Input)
P0048	Turbo Boost Control Solenoid (Auto) Circuit Malfunction (High Input)
P0072	Boost Air Temp Sensor Circuit Malfunction (Low Input)
P0073	Boost Air Temp Sensor Circuit Malfunction (High Input)
P0088	Fuel Pressure Sensor Malfunction
P0089	Suction Control Solenoid Stuck
P0093	Fuel Leak Problem
P0102	Mass Airflow Sensor Malfunction (Low Input)
P0103	Mass Airflow Sensor Malfunction (High Input)
P0106	Manifold Absolute Pressure Sensor Range/ Performance Problem
P0107	Manifold Absolute Pressure Sensor Circuit Malfunction (Low Input)
P0108	Manifold Absolute Pressure Sensor Circuit Malfunction (High Input)
P0112	Inlet Air Temp Sensor Circuit Malfunction (Low Input)
P0113	Inlet Air Temp Sensor Circuit Malfunction (High Input)
P0117	Engine Coolant Temperature Sensor Circuit Malfunction (Low Input)
P0118	Engine Coolant Temperature Sensor Circuit Malfunction (High Input)
P0122	Throttle Position Sensor Circuit Malfunction (Low Input)
P0123	Throttle Position Sensor Circuit Malfunction (High Input)
P0182	Fuel Temp Sensor Circuit Malfunction (Low Input)
P0183	Fuel Temp Sensor Circuit Malfunction (High Input)

Code #	Fault
P0191	Fuel Pressure Sensor Range/ Performance Problem
P0192	Fuel Pressure Sensor Circuit Malfunction (Low Input)
P0193	Fuel Pressure Sensor Circuit Malfunction (High Input)
P0201	Fuel Injector #1 Circuit Malfunction
P0202	Fuel Injector #2 Circuit Malfunction
P0203	Fuel Injector #3 Circuit Malfunction
P0204	Fuel Injector #4 Circuit Malfunction
P0219	Engine Over Speed Condition
P0234	Turbocharger Over Boost Condition (Manual)
P0301	Fuel Injector #1 Circuit Malfunction (No Injection)
P0302	Fuel Injector #2 Circuit Malfunction (No Injection)
P0303	Fuel Injector #3 Circuit Malfunction (No Injection)
P0304	Fuel Injector #4 Circuit Malfunction (No Injection)
P0335	Crankshaft Position Sensor System
P0336	Crankshaft Position Sensor Range/ Performance Problem
P0340	Camshaft Position Sensor System
P0341	Camshaft Position Sensor Range/ Performance Problem
P0403	Exhaust Gas Recirculation (EGR) Valve Servo Motor Malfunction
P0405	EGR Valve Position Sensor Circuit Malfunction (Low Input)
P0406	EGR Valve Position Sensor Circuit Malfunction (High Input)
P0420	Catalyst Malfunction (Auto)
P0427	Exhaust Temp Sensor #2 Circuit Low Input (Auto)
P0428	Exhaust Temp Sensor #2 Circuit High Input (Auto)

Code #	Fault	Code #	Fault
P0472	Exhaust Pressure Sensor Circuit Low Input (Auto)	P1498	Excessive Particulate Material Accumulated in Diesel Particulate Filter (Auto)
P0473	Exhaust Pressure Sensor Circuit High Input (Auto)	P1499	Diesel Particulate Filter Temp Abnormally High (Auto)
P0502	Vehicle Speed Sensor Circuit Malfunction (Low Input)	P1564	Cruise Control Switch System
P0513	Immobiliser Malfunction	P1571	Brake Light Switch System
P0545	Exhaust Temp Sensor #1 Circuit Low Input (Auto)	P1625	Fuel Injector Calibration Data (Stored Correction Value Error)
P0546	Exhaust Temp Sensor #1 Circuit High Input (Auto)	P1626	Fuel Injection Calibration Data (Stored Correction Value Not Recorded)
P0551	Power Steering Pressure Switch System	P2009	Swirl Control Solenoid Circuit Malfunction (Low Input)
P0603	ECM EEP-ROM Malfunction	P2010	Swirl Control Solenoid Circuit Malfunction (High Input)
P0604	ECM Random Access Memory (RAM) Malfunction	P2118	Throttle Valve Servo Motor Malfunction (Current Control)
P0605	ECM Read Only Memory (FLASH ROM) Malfunction	P2122	Accelerator Pedal Position Sensor (Main) Circuit Malfunction (Low Input)
P0606	ECM Main Processor Malfunction	P2123	Accelerator Pedal Position Sensor (Main) Circuit Malfunction (High Input)
P0607	ECM Sub Processor Malfunction	P2124	Accelerator Pedal Position Sensor (Main) Malfunction (Intermittent High Input)
P0628	Suction Control Solenoid Malfunction (Open Circuit)	P2127	Accelerator Pedal Position Sensor (Sub) Circuit Malfunction (Low Input)
P0629	Suction Control Solenoid Malfunction (Short to Power)	P2128	Accelerator Pedal Position Sensor (Sub) Circuit Malfunction (High Input)
P0630	Chassis Number Not Programmed	P2138	Accelerator Pedal Position Sensor (Main / Sub) Range/ Performance Problem
P0638	Throttle Valve Control Servo Motor Malfunction (Stuck)	P2146	Fuel Injector #1 and 4 Power Drive Circuit Open
P0642	Accelerator Pedal Position Sensor (Main) Supply Voltage Too Low	P2147	Fuel Injector Power Drive Circuit Malfunction (Low Input)
P0643	Accelerator Pedal Position Sensor (Main) Supply Voltage Too High	P2148	Fuel Injector Power Drive Circuit Malfunction (High Input)
P0652	Sensor Supply Voltage Too Low (All Except Accelerator Pedal Position Sensor - Main)	P2149	Fuel Injector #2 and 3 Power Drive Circuit Open
P0653	Sensor Supply Voltage Too High (All Except Accelerator Pedal Position Sensor - Main)	P2228	Barometric Pressure Sensor (Internal Within ECM) Malfunction (Low Input)
P1203	Capacitor Insufficient Charging (Fuel Injector Drive Circuit)	P2229	Barometric Pressure Sensor (Internal Within ECM) Malfunction (High Input)
P1204	Capacitor Excessive Charging (Fuel Injector Drive Circuit)	P2413	Exhaust Gas Recirculation System Performance
P1272	Fuel Pressure Limiter Malfunction	P2454	Exhaust Differential Pressure (DP) Sensor Circuit Low Input (Auto)
P1273	Fuel Supply Pump Insufficient Flow	P2455	Exhaust Differential Pressure (DP) Sensor Circuit High Input (Auto)
P1274	Fuel Supply Pump Protection (Fuel Pressure Abnormal)	P252F	Engine Oil Level Excessive (DPF Regeneration / Oil Dilution) (Auto)
P1275	Fuel Supply Pump Exchange (Fuel Pressure Remains Above Limit)	U1073	Controller Area Network (CAN) Communication Bus OFF
P1298	Turbo Boost Control Solenoid (Auto) System Malfunction (High Pressure)	U1101	Auto Trans ECM Time-out CAN Communication Bus
P1299	Turbo Boost Control Solenoid (Auto) System Malfunction (Low Pressure)	U1102	ASTC System ECM Time-out CAN Communication Bus
P1427	Exhaust Temp Sensor #3 Circuit Low Input (Auto)	U1108	Instrument Cluster ECU Time-out CAN Communication Bus
P1428	Exhaust Temp Sensor #3 Circuit High Input (Auto)	U1109	Body Control Module Time-out CAN Communication Bus
P1474	Engine Bay Temp Sensor Circuit Low Input (Auto)	U1117	Immobiliser Module Time-out CAN Communication Bus
P1475	Engine Bay Temp Sensor Circuit High Input (Auto)		
P1497	Diesel Particulate Filter (DPF) System Malfunction (Auto)		

Accelerator Pedal Position Sensor

The Accelerator Pedal Position Sensor is mounted to the accelerator pedal arm. It incorporates two non-contact hall element type Sensors:

Accelerator Pedal Position Sensor (Sub)

Accelerator Pedal Position Sensor (Main)

The ECM monitors this combined sensor to determine the basic fuel injection amount.

Fail-Safe Mode:

Should one of the Sensors fail, the ECM will revert to a fail-safe mode. In this mode the remaining Sensor signal is rendered to half its output value.

If both Sensors fail, the ECM fail-safe mode will restrict engine speed to 1,300 RPM approx.

This allows for minimal driving to a place of repair.

To Test Voltage:

See ECM Pin #B22, B23, B24, B30, B31 and B32.

A/C Condenser Relay (If Fitted)

A/C Condenser Fan Relay is located in the engine bay fuse / relay box, next to the battery. The ECM will actuate this relay to operate the A/C Condenser Fan Motor.

This is in response to changes in engine coolant temperature, vehicle speed and A/C operation.

To Test Voltage:

See ECM Pin #A39.

Note!

The A/C Condenser Fan Relay is fitted to models equipped with a dual A/C system.

Air Conditioner Condenser Fan

The Air Conditioner Condenser Fan is located with the A/C Condenser. The ECM controls this Fan (single speed) using the A/C Condenser Fan Relay.

Air Conditioner Compressor Relay

The A/C Compressor Relay is located in the engine bay relay box, next to the battery. The ECM will actuate this relay to operate the Air Conditioner Compressor Clutch.

Relay activation is dependant upon A/C System inputs, and engine operating conditions.

To Test Voltage:

See ECM Pin #A13, A15 and A40.

Air Conditioner System ECU

The A/C System ECU is located with the central heater controls. It is monitored by the ECM for information relating to A/C status / load.

Based on this and other inputs, the ECM will activate;

- A/C Condenser Fan Relay
- Air Conditioner Compressor Relay

To Test Voltage:

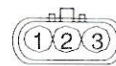
See ECM Pin #A13 and A15.

A/C Pressure Sensor

The Air Conditioner Pressure Sensor is located in the A/C high-pressure liquid line, below the battery. This Sensor measures refrigerant pressure (high/low) and provides a signal to the A/C System ECU. This then forms part of the A/C status / load signal communicated to the ECM.

To Test:

1. Connect manifold gauges to A/C charge ports
2. Engine running.
3. A/C compressor operating.
4. Ensure high-pressure reading is between 1,100 and 1,900 kPa.
5. Inspect voltage at Terminal 2 – should be 1.5 to 3 Volts.



- 1 = 5 Volts Supply from A/C System ECU
- 2 = Signal Return to A/C System ECU
- 3 = Sensor Ground to A/C System ECU

Mitsubishi 4M41 A/C Pressure Sensor Connector
(Backprobing View From Harness Side)

To Test Voltage:

See ECM Pin #A13 and A15.

Auto Trans ECM

The Auto Trans ECM is located on a mounting bracket, behind the glove box. The Engine ECM monitors the Auto Trans ECM via the CAN Communication Bus.

To Test Voltage:

See ECM Pin #B27 and B35.

Auto Trans Inhibitor Switch

The Inhibitor Switch is incorporated with the Auto Trans Range Switch. It is located on the left side of the transmission casing. It allows the engine to start only when the Auto Trans is in (P) or (N) - Positions.

To Test Voltage:

See ECM Pin #B13.

ASTC System ECM

The Active Stability and Traction Control System ECM is located behind the centre console. The ECM monitors the various ASTC ECM inputs for traction control demand. This is carried out via the CAN Communication Bus. Based on information received, the ECM may control engine output.

To Test Voltage:

See ECM Pin #B27 and B35.

Barometric Pressure Sensor

The Barometric Pressure Sensor an internal type, located within the ECM. The ECM monitors this sensor to determine the barometric air pressure. It will make adjustments to accommodate for changes in altitude.

Body Control Module

The Body Control Module is located with the interior junction box, at the right end of the dash. Two different protocols are used on these vehicles for network serial communication:

- Mitsubishi Smart Wiring System (SWS) low speed network protocol.
- High Speed CAN (Controller Area Network) Communication Bus protocol.

The Body Control Module acts as a portal for bi-directional translation between protocols. This ensures data exchange between the different speed networks.

To Test Voltage:
See ECM Pin #B27 and B35.

Note!

The remote keyless entry system is integrated with the Body Control Module.

CAN Network Testing

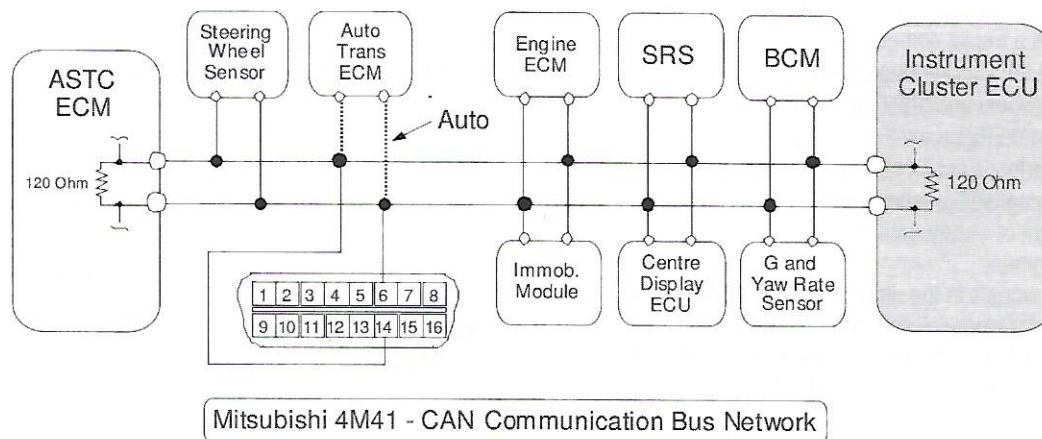
The CAN Communication Bus network is formed using parallel connections. Each end of the CAN Bus has a 120 Ohm terminating resistor. The resistors are located in the Instrument Cluster ECU and ASTC System ECM.

To Test Resistance:

Disconnect negative battery terminal.

Measure across the 16 Pin Diagnostic Connector

Terminals 6 and 14 - should be 60 Ohms approx.



Note!

If the CAN Bus is shorted then all communication will cease (BUS OFF failsafe function).

To Test Voltage:
See ECM Pin #B27 and B35.

Function Test:

Confirm that the Tachometer is operating.
(Engine speed signal is sent from the ECM to the Instrument Cluster ECU via the CAN Bus).

Confirm that the Engine Temperature Gauge is operating.
(Engine coolant temp signal is sent from the ECM to the Instrument Cluster ECU via the CAN Bus).

Boost Air Temp Sensor

The Boost Air Temp Sensor is located on top of the main air inlet tube. The ECM monitors boost inlet air temperature using this Sensor. It is also used to provide feedback to the ECM during EGR operation.

To Test Voltage:
See ECM Pin #A65 and A75.

To Test Resistance:

Disconnect Connector, measure between Terminals.

Temperature	Resistance
20°C	2 to 3 k Ohms
40°C	0.9 to 1.5 k Ohms
80°C	0.23 to 0.42 k Ohms

Brake Light Switch

The Brake Light Switch is located at the pedal cluster. The ECM monitors this switch to determine when the brakes have been applied. A second set of contacts are used for Cruise Control operation.

To Test Voltage:
See ECM Pin #A34 and B4.

Camshaft Position Sensor

The Camshaft Position Sensor is a magnetic resistive element type. It is situated on the front surface of the timing case, in front of the idler timing gear.

The trigger plate has 4 evenly spaced teeth with an extra tooth for TDC (5 in total). The trigger plate is part of the idler timing gear and is not serviced separately. The ECM monitors this Sensor for cylinder identification, and TDC position.

To Test Voltage:
See ECM Pin #A57, A59 and A78.

Note!

Check with an oscilloscope for square wave pattern and frequency changing with engine speed.

Centre Display ECU

The Centre Display ECU is located in the centre dash, above the audio unit. The ECM communicates with the Centre Display ECU using the CAN Communication Bus.

To Test Voltage:
See ECM Pin #B27 and B35.

Clutch Switch (Manual)

The Clutch Switch is located at the pedal cluster. The ECM monitors this switch to determine the clutch pedal position. It is used as part of the cruise control function within the ECM.

To Test Voltage:
See ECM Pin #B5.

Combination Switch ECU

The Combination Switch ECU is integrated with the combination switch assembly. It is part of the Mitsubishi Smart Wiring System (SWS) Low Speed Network. The combination switch signals are monitored via the SWS Network. In addition to this monitoring, an input request signal circuit is used (uni-directional). This circuit is between the Body Control Module and the Combination Switch ECU.

Clock Spring

The Clock Spring (a coil of Flat Ribbon Wire) is positioned under the steering wheel. It provides a permanent contact throughout movement of the steering wheel. It allows contact for the cruise control switch, horn, audio controls and airbag wiring harness. The Clockspring is a fragile component.

To avoid breaking the Clockspring ensure:

- The steering wheel and steering system remain locked when working on them.
- The Clock Spring is not forcibly turned, or over-wound.
- The Clockspring is aligned correctly when re-installed.

Clock Spring Alignment:

1. Set the front wheels in the straight-ahead position.
2. Turn the Clock Spring fully clockwise (until it stops).
3. Turn the Clock Spring counter-clockwise 3.75 turns.
4. Align marks on Clock Spring and outer housing.

To Test Voltage:
See ECM Pin #A43 and A66.

Note!

When installing Clock Spring and steering wheel, ensure that all mating surfaces are correctly aligned.

Control Module (ECM)

The 2 Connector 121 Pin ECM is located behind the left side under-dash area, being mounted vertically.

Warning!

High voltages are used to operate the Fuel Injectors. Ensure ignition is OFF before touching or disconnecting the Injector wiring.

Note!

If ECM replacement is required, the ignition key(s) need to be replaced in conjunction with it.

The Mitsubishi MUT III Scan Tool is required for the ECM programming functions:

- Vehicle Chassis Number writing, and Key ID Code registration using Immobiliser Module data.
- Fuel Injector Calibration Code writing, and Fuel Injection Idle Quantity learnt value.

Crankshaft Position Sensor

The Crankshaft Position Sensor is a magnetic resistance element type. It is located on the bottom of the timing case, at the crankshaft drive gear. It provides a signal to the ECM in relation to engine speed and crank angle. This Sensor is triggered by a 60 tooth plate (with 4 missing teeth). The trigger plate is located on the front of the crankshaft inside the timing case.

Note!

Check with an oscilloscope for square wave pattern and a frequency changing with engine speed.

The trigger plate missing teeth will be evident on the output pattern.

To Test Voltage:
See ECM Pin #A58, A60 and A79.

Cruise Control Indicator Lamp

The Cruise Control Indicator Lamp is located in the Instrument Cluster. It is controlled by the ECM via the CAN Communication Bus. The ECM will illuminate this Lamp based on signals from the Cruise Control Switch.

To Test Voltage:
See ECM Pin #A43 and A46, B27 and B35.

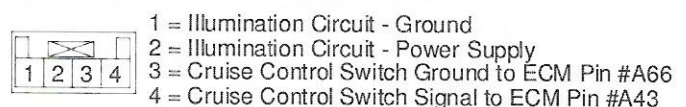
Cruise Control Switch

The Cruise Control Switch is located on the right side of the steering wheel. The switches are connected through the Clockspring to the ECM. The ECM monitors these switches for cruise demand. Each switch produces a different level voltage signal, requesting a specific cruise function.

To Test Voltage:
See ECM Pin #A43 and A66.

To Test Resistance:

1. Disconnect connector.
2. Remove Cruise Control Switch Assembly.
3. Measure between Terminals 3 and 4.



Mitsubishi 4M41 Cruise Control Switch
(Backprobing View From Harness Side)

Switch Pressed	Resistance
All Switches OFF	Open Circuit
ON/OFF (MAIN) Switch ON	<2 Ohms
CANCEL Switch ON	202.5 to 208 Ohms
COAST/SET Switch ON	610.5 to 624.5 Ohms
ACC/RES Switch ON	1838 to 1877 Ohms

Cruise Control System

Cruise Control is carried out internally by the ECM. The ECM controls cruise through fuel injection quantity / timing, to achieve the target vehicle speed.

Diesel Particulate Filter (Auto)

The Diesel Particulate Filter is a part of the DPF System. It is located in the exhaust system directly behind the catalytic converter.

The DPF is used to store and remove diesel particulate matter (soot). This is produced during incomplete diesel combustion.

DPF Lamp (Auto)

The Diesel Particulate Filter Lamp is located in the Instrument Cluster. It is controlled by the ECM via the CAN Communication Bus. The ECM will illuminate this Lamp based DPF System status.

Lamp illumination is based on ECM calculations for:

- Particulate matter amount in the DPF.
- Engine oil dilution amount.

To Test Voltage:

See ECM Pin #B27 and B35.

DPF System (Auto)

The Diesel Particulate Filter System is used to manage the emission of particulate matter (soot). Particulate matter is the result of incomplete diesel combustion under certain driving conditions.

The Diesel Particulate Filter (DPF) is used for storage of particulate matter produced. To remove particulate matter, the DPF regeneration process is performed. This process is controlled by the ECM based on monitored parameters.

The DPF System includes;

- Catalytic Converter (increases exhaust temp during Regeneration).
- Engine Bay Temp Sensor.
- Exhaust Differential Pressure (DP) Sensor.
- Exhaust Pressure Sensor.
- Exhaust Temp Sensor #1, #2 and #3.
- Diesel Particulate Filter (DPF).
- DPF Regeneration Process.
- Engine Oil Dilution Monitoring.
- DPF Lamp.

Note!

After replacing DPF System components, inspect the ECM for related learning values to be initialised. These functions are performed using the Mitsubishi MUT III Scan Tool.

DPF Regeneration (Auto)

The Diesel Particulate Filter regeneration process is required as part of the DPF System. This process is used to burn off accumulated particulate matter within the DPF.

The accumulation amount is calculated by the ECM based on monitored parameters. If this calculation exceeds set parameters, the ECM determines that regeneration is required.

Automatic DPF Regeneration Requirements:

This can be carried out by the ECM when;

- Engine is at normal operating temperature.
- Auto Trans Selector is in (D) - Position.
- Vehicle speed is >40 km/h.
- Amount of accumulated particulate matter exceeds specified value.

Note!

If regeneration is required the ECM may illuminate the DPF Lamp in the Instrument Cluster.

This encourages the driver to ensure the requirements are met to enable regeneration.

Process:

During DPF regeneration, the exhaust temp is artificially increased to 600°C approx. This is achieved using ECM controls affecting fuel, timing, air and turbocharger operation.

The stored particulate matter is then burnt from the DPF, during this high temp phase. Feedback of the regeneration process is provided by various ECM sensors.

Should any of the DPF regeneration requirements not longer be met, the process will cease.

Note!

An interrupted regeneration process may contribute to increasing the engine oil dilution amount.

Engine oil dilution results from the ECM use of a post-injection as part of catalyst activation.

This causes exhaust temperature to increase.

Manual DPF Regeneration:

If continued automatic regeneration attempts are interrupted, the particulate matter amount increases. Should this occur then the ECM may illuminate the MIL, and flash the DPF Lamp.

As a result forced Manual Regeneration will be required, using the Mitsubishi MUT III Scan Tool.

To Test:

Ensure:

DPF System is operating normally (Inspect Fault Codes).

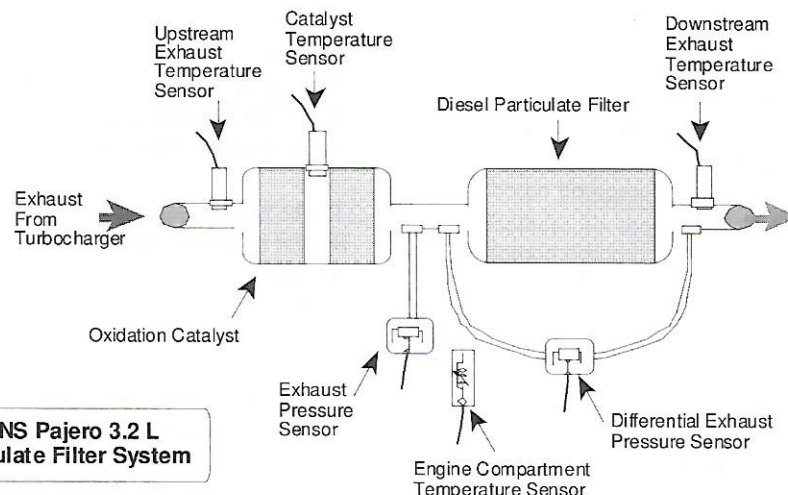
Engine is at normal operating temp (80°C to 90°C).

Auto Trans Selector Lever in (P) - Position.

All accessories and loads are OFF.

Steering Wheel Stationary.

Vehicle on a level surface, in a well ventilated area, away from combustible materials



EGR Cooler

The EGR Cooler is located above the exhaust manifold. It is used by the EGR System to cool the exhaust gas prior to recirculation.

EGR System

The Exhaust Gas Recirculation System incorporates;

- EGR Valve (With Servo Motor).
- EGR Valve Servo Motor.
- EGR Valve Sensor.
- EGR Cooler.
- Electronic Throttle Control.

It enables circulation of a portion of exhaust gases back into the intake manifold. This reduces combustion temperature and exhaust emissions.

During EGR operation additional engine vacuum may be required. This vacuum is provided by ECM operation of the electronic throttle valve.

EGR Valve

The Exhaust Gas Recirculation Valve is located on top of the main air inlet tube. This Valve is used to recirculate a portion of exhaust gas back into the intake manifold.

The ECM controls this Valve using the EGR Valve Servo Motor.

EGR Valve Sensor

The hall element Exhaust Gas Recirculation Valve Sensor is located on the end of the EGR Valve.

It is used by the ECM to monitor the EGR Valve position.

This Sensor provides feedback for the EGR System.

To Test Voltage:

See ECM Pin #A51, A72 and A80 EGR Valve Servo Motor

The Exhaust Gas Recirculation Valve Servo Motor is located with the EGR Valve. It is part of the Exhaust Gas Recirculation System. The ECM drives this Servo to move the EGR Valve to the desired position.

To Test Voltage:

See ECM Pin #A19 and A20.

Electronic Throttle Control

The Electronic Throttle Control function is integrated within the ECM. This function includes control of the throttle valve using a Servo Motor in the throttle body. During normal operating conditions the ECM will open the throttle valve fully.

The ECM will close the throttle valve during;

- EGR Valve operation (variable closure angle).
- DPF Regeneration (variable closure angle).
- 3 Seconds after engine shut down.
- When a major engine control malfunction occurs.

Emission Controls

These vehicles are able to comply with Euro 4 Emission standards.

Emission controls include:

Auto Models:

- Exhaust Gas Recirculation System.
- Diesel Particulate Filter System.
- ECM Monitoring and Failure Detection.
- 1 Down-stream Catalytic Converter.

Manual Models:

- Exhaust Gas Recirculation System.
- ECM Monitoring and Failure Detection.
- 1 Close-coupled Catalytic Converter.
- 1 Down-stream Catalytic Converter.

Engine Bay Temp Sensor (Auto)

The Engine Bay Temp Sensor is located at the fire wall. It is situated together with the Exhaust Differential Pressure Sensor. The ECM provides compensation to the overall particulate matter calculation using this Sensor. This Sensor is part of the DPF System.

To Test Voltage:

See ECM Pin #A44 and A69.

To Test Resistance:

Disconnect Connector, measure between Terminals.

Temperature	Resistance
20°C	2 to 2.9 k Ohms
40°C	0.98 to 1.4 k Ohms
80°C	0.25 to 0.45 k Ohms

Engine Control Relay

The Engine Control Relay is located in the engine bay relay box, next to the battery. It is used to provide power to the ECM and related sensors and actuators.

To Test Voltage:

See ECM Pin #B9, B10 and B19.

Engine Coolant Temp Sensor

The Engine Coolant Temp Sensor is located in the upper radiator hose housing. The ECM monitors this Sensor to determine actual coolant temperature. This signal is communicated to the Instrument Cluster ECU via the CAN Communication Bus.

To Test Voltage:

See ECM Pin #A53 and A74.

To Test Resistance:

Disconnect Connector, measure between Terminals:

Temperature	Resistance
20°C	2.1 to 2.7 k Ohms
40°C	0.9 to 1.3 k Ohms
80°C	0.26 to 0.36 k Ohms

Engine Oil Dilution

Engine Oil Dilution Monitoring is part of the DPF System.

The engine oil level (increase / decrease) is calculated by the ECM. This is based upon vehicle driving conditions, and interrupted DPF Regeneration Processes.

The ECM may flash the DPF Lamp if calculated engine oil dilution exceeds target value. If confirmed, then engine oil replacement will be necessary. Also inspect ECM for the Fault Codes relating to the DPF System.

Note!

After replacing the engine oil, the ECM engine oil learning value needs to be initialised.

This function is performed using the Mitsubishi MUT III Scan Tool.

Engine Speed Limiter

The ECM will restrict engine speed to 3,000 RPM using fuel injection control while;

- Transmission is in first or reverse gear.
- Vehicle speed is < 5km/h.

This is to protect the drive train from excessive loadings.

Engine Temperature Gauge

The Engine Temperature Gauge is located within the Instrument Cluster. An engine coolant temp signal is provided to the Instrument Cluster ECU via the CAN Bus.

This signal is used for calculation of the gauge position.

Exhaust DP Sensor (Auto)

The piezo resistive element Exhaust Differential Pressure Sensor is located at the fire wall. It is situated together with the Exhaust Pressure Sensor.

The Exhaust DP Sensor has 2 pressure ports leading toward the DPF. It is used to sense the difference in pressure upstream and downstream of the DPF.

The ECM is able to calculate the particulate matter amount in the DPF using this signal.

This Sensor is part of the DPF System.

To Test Voltage:

See ECM Pin #A46, A67 and B30.

Exhaust Pressure Sensor (Auto)

The piezo resistive element Exhaust Pressure Sensor (single port) is located at the fire wall. It is situated together with the Exhaust DP Sensor. The Exhaust Pressure Sensor has a single pressure port leading toward the DPF. The ECM provides compensation to the overall particulate matter calculation using this Sensor. This Sensor is part of the DPF System.

To Test Voltage:

See ECM Pin #A63, A67 and B30.

Exhaust Temp Sensors (Auto)

These vehicles use three separate Exhaust Temp Sensors (thermistor type).

They are situated in the exhaust system;

- Exhaust Temp Sensor #1 (upstream of the catalytic converter)
- Exhaust Temp Sensor #2 (mid area of the catalytic converter – catalyst temp)
- Exhaust Temp Sensor #3 (downstream of the DPF – DPF temp)

The ECM monitors these Sensor signals primarily during the DPF regeneration process. They form part of the DPF System.

To Test Voltage:

See ECM Pin #A47, A48, A68, A69, B16 and B17.

To Test Resistance:

Disconnect connector.

Measure between Terminals

Should be 120 to 560 k Ohms @ 20°C.

Front (Engine Bay) ECU

The Front (Engine Bay) ECU is located with the engine bay fuse / relay box. It is part of the Mitsubishi Smart Wiring System (SWS)

Low Speed Network. Control of various relay functions are carried out by the Front (Engine Bay) ECU. This control is performed based on signals provided over the SWS Network.

Fuel Filter Assembly

The Fuel Filter Assembly is located on a bracket on the left side of the fire wall. It incorporates the Water Separator Switch and a Manual primer pump.

To prime; press manual primer pump until it becomes firm.

Fuel Injectors

The Fuel Injectors are located in the cylinder head and protrude through the rocker cover. They are operated sequentially using multiple injections by the ECM. If an injector requires replacement, perform the Fuel Injector Calibration Code procedure.

Warning!

The Injectors operate up to 100 Volts approx.

Ensure ignition switch is OFF before removing connectors.

To Test Resistance @ 20°C:

Disconnect connector, measure between Terminals

Should be 0.45 Ohms approx.

To Test Voltage:

See ECM pin #A1, A2, A3, A4, A5, A6, A23, A24, A25 and A26.

Fuel Injector Calibration Code

The Calibration Code is a unique 30 digit alphanumeric value, printed on the head of each injector. If an injector is replaced, ECM programming functions are required for this new injector. These include:

- Fuel Injector Calibration Code writing (using new injector code).
- Fuel Injection Idle Quantity learnt value.

The Mitsubishi MUT III Scan Tool will be necessary for these functions.

If any of these programming functions are not completed correctly:

- Engine noise / rattle may be evident.
- Engine idle may become rough.
- Deterioration occurs in emission levels and engine operation.
- Fault Codes may be stored in the ECM.

Note!

If the ECM is replaced, all existing fuel injector Calibration Codes must be written to the new ECM

Fuel Injector Pipes

The high pressure Fuel Injector Pipes are able to be re-used up to 5 times. This is provided the same common rail injection components are re-used. If unable to verify the number of times used, then replace the Fuel Injector Pipes.

Warning!

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.

Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes.

Fuel Injection Idle Quantity

The Fuel Injection Idle Quantity is a learnt value stored in the ECM. This value will adapt pre-injection control to suit variations in engine operation.

NOTE!

This procedure is required after Fuel Injector Calibration Code writing to the ECM.

To Test:

Ensure:

Engine at normal operating temp (80°C to 90°C), Auto Trans Fluid Temp >60°C (Auto), Gearbox in Neutral (Manual).
Selector in (P) - Position (Auto), All accessories and loads are OFF, Steering wheel stationary.

Procedure:

1. Connect Mitsubishi MUT III Scan Tool to Diagnostic Connector.
2. Activate special function for injection quantity learn value.
3. Continue idling for 3 minutes approx. before learning is completed.
4. Confirm that MIL is not illuminated.

Note!

If MIL continues to flash after procedure, repeat learning process again.

Fuel Injection Timing

Fuel Injection Timing is ECM controlled and is not adjustable. Multi-stage injection control is utilised during various driving modes.

- Pre-Injection (primarily for reducing combustion noise and emissions).
- Main Injection.
- Post-Injection (primarily as part of catalyst activation during DPF Regeneration).

Fuel Pressure

Fuel Pressure is regulated within the Fuel Supply Pump Assembly. The ECM controls the Suction Control Solenoid position, to obtain the desired fuel pressure.

This adjusts the feed pump supply to the high pressure pump, and resultant pressure.

Fuel pressure can be read using the Mitsubishi MUT III Scan Tool. Maximum fuel pressure is limited by the Fuel Pressure Limiter on the common rail.

Note!

Engine idling fuel pressure is 20,000 to 35,000 kPa approx.

Fuel Pressure can reach pressures of up to 180,000 kPa approx.

Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes.

Fuel Pressure Sensor

The Fuel Pressure Sensor is located at the rear of the common rail. The ECM monitors this Sensor to determine fuel pressure. It is also utilised as feedback for Suction Control Solenoid operation.

To Test Voltage:

See ECM Pin #A56, A76 and A81.

Note!

Do not remove Fuel Pressure Sensor from the common rail.

If removed, the common rail must be replaced as an assembly.

Fuel Pressure Limiter

The Fuel Pressure Limiter valve is located at the front of the common rail. It will open to release excessive fuel pressure in the rail, should this occur. This is to protect the common rail components.

Note!

Do not remove Fuel Pressure Limiter from the common rail.

If removed, the common rail must be replaced as an assembly.

Fuel Supply Pump Assembly

The Fuel Supply Pump Assembly is located at the right front of the engine.

It contains:

- Feed Pump with Regulator Valve.
- High Pressure Pump (twin plunger type).
- Suction Control Solenoid.
- Inlet Valve.
- Delivery Valve.
- Fuel Temp Sensor.

Operation:

The Fuel Supply Pump draws fuel from the fuel tank using the feed pump.

Fuel is then supplied to the high pressure pump, via the Suction Control Solenoid, then passes through the inlet valve into the high pressure pump.

Once pressure builds to a certain level, the delivery valve allows fuel supply to the common rail.

Fuel pressure is controlled by changing the amount of fuel supplied to the high pressure pump. This is achieved by varying the position of the ECM controlled Suction Control Solenoid.

NOTE!

If replaced, the fuel supply pump correction value needs to be learnt by the ECM.

This value relates to the Suction Control Solenoid duty cycle, at a specific common rail pressure.

The Mitsubishi MUT III Scan Tool will be necessary for this learn function.

Fuel Temp Sensor

The Fuel Temp Sensor is located in the rear of the Fuel Supply Pump Assembly. The ECM monitors this Sensor to make corrections based on fuel temperature. It is also used as part of the Fuel Injection Idle Quantity learnt value.

NOTE!

The Fuel Temp Sensor is not serviced separately from the Fuel Supply Pump Assembly.

To Test Voltage:

See ECM Pin #A54 and A75.

To Test Resistance @ 20°C:

Disconnect Connector, measure between terminals:
Should be 2 to 3 k Ohms.

Fuse / Fusible Link Locations

The following Fusible Link is located with the battery in the engine bay:

Fusible Link 33 (80Amp) – Battery

The following Fuses are located in the engine bay fuse / relay box:

Fuse 10 (25Amp) – Engine Bay

Fuse 16 (15Amp) – Engine Bay

Fuse 18 (15Amp) – Engine Bay

Fuse 19 (10Amp) – Engine Bay

The following Fusible Links are located in the engine bay fuse / relay box:

Fusible Link 1 (140Amp) – Engine Bay

Fusible Link 2 (60Amp) – Engine Bay

Fusible Link 3 (40Amp) – Engine Bay

Fusible Link 5 (20Amp) – Engine Bay

The following Fuses are within the interior junction box, located at the right end of the dash panel:

Fuse 2 (7.5Amp) - Interior JB

Fuse 3 (7.5Amp) - Interior JB

Fuse 5 (7.5Amp) - Interior JB

Fuse 8 (7.5Amp) - Interior JB

Fuse 15 (15Amp) - Interior JB

G And Yaw Rate Sensor

The G And Yaw Rate Sensor is located under the centre console. This Sensor is part of the Active Stability and Traction Control (ASTC) System.

It is used to detect lateral and longitudinal acceleration and yaw rate of the vehicle.

This is used by the ASTC System when calculating traction control demand. ECM monitoring of this demand is carried out via the CAN Communication Bus

Based on information received, the ECM may control engine output.

To Test Voltage:

See ECM Pin #B27 and B35.

Glow Plugs

The Glow Plugs are located in the cylinder head.

They are equipped with a regulating resistor to maintain a constant glow temperature. The ECM controls operation of the Glow Plugs using the Glow Plug Relay.

To Test Resistance @ 20°C:

Disconnect wiring and glow plug plate, test individually :

Should be 0.5 to 1.5 Ohms.

Glow Plug Indicator Lamp

The Glow Plug Indicator Lamp is located in the Instrument Cluster. During pre-glow control phase this Lamp is illuminated by the ECM. This is carried out via the CAN Communication Bus. It is also used to inform the driver of the suitable time to start the engine.

To Test Voltage:

See ECM Pin #B27 and B35.

Glow Plug Relay

The Glow Plug Relay is located on a bracket at the right front strut tower. The ECM switches this relay to control operation of the Glow Plugs.

To Test Voltage:

See ECM Pin #A29.

Glow Plug System

The Glow Plug System heats the combustion chambers to aid cold engine starting / running. The ECM controls this System through actuation of the Glow Plug Relay.

Two modes of operation can occur:

Pre-glow control phase:

Ignition ON or Cranking.

Engine Coolant Temp <60°C.

Maximum activation time for Relay is 10 seconds (varies with coolant temp).

Glow Plug Indicator Lamp illuminates.

After-glow control phase:

Engine immediately after starting.

Engine Speed >350 RPM.

Engine Coolant Temp <60°C.

Maximum activation time for Relay is 180 seconds (varies with coolant temp).

Idle Speed (Base)

Idle speed is ECM controlled and is not adjustable.

The ECM manages idle speed using fuel injection delivery and timing.

To Test:

Ensure:

Engine is at normal operating temp (80°C to 90°C).

Selector Lever in (P) - Position (Auto).

Gearbox in Neutral (Manual).

All accessories and loads are OFF.

Steering Wheel Stationary.

Inspection:

Run engine until idle speed stabilises (minimum two minutes).

Check idle speed against specification:

- 670 to 730 RPM (Manual).
- 710 to 770 RPM (Auto).

Ignition Key Transponder

The Ignition Key Transponder is contained within the key head. Within the key is also the high frequency transmitter for the keyless entry system. Both the ignition key transmitter and the immobiliser key transponder contain a unique ID code.

Each Key Transponder ID must be registered in the Immobiliser Module before it can start the vehicle.

A maximum of 8 keys may be registered in the Immobiliser Module. The Ignition Key Transponder forms part of the Immobiliser System.

Ignition Lock Antenna

The Ignition Lock Antenna is located with the ignition switch. The Immobiliser Module controls the Ignition Lock Antenna operation. This forms part of the Immobiliser System.

Immobiliser Module

The Immobiliser Module is located on the right of the centre console, next to the diagnostic connector. This Module forms part of the Immobiliser System. ECM communication with the Immobiliser Module is via the CAN Communication Bus.

To Test Voltage:

See ECM Pin #B27 and B35.

Note!

If Immobiliser Module replacement is required, registration of all key ID codes is necessary.

The Mitsubishi MUT III Scan Tool is required for this programming function.

Immobiliser System

The Immobiliser system is used to prevent unauthorised use of the vehicle.

This is achieved by immobilising the engine if start attempts are made, using an unregistered key.

This System is independent of the remote keyless entry system.

The Immobiliser System incorporates:

- Immobiliser Module.
- Ignition Key Transponder.
- Ignition Lock Antenna.
- ECM - Immobilises the engine.

Immobilisation System Operation:

- Data exchange between the ECM and Immobiliser Module is via the CAN Communication Bus.
- With Ignition ON the Immobiliser Module will power the Ignition Lock Antenna.
- This energises the Ignition Key Transponder (with a unique key ID code).
- The Immobiliser Module passes a random number via the antenna to the transponder.
- The antenna then returns the random number and key ID code after transponder processing.
- If the key is registered, the Immobiliser Module will request the ECM to mobilise the engine.
- If unregistered, the Immobiliser Module will request the ECM to immobilise the engine (stall).

Note!

Avoid transponder interference from keys / metal objects on the same ring as the Ignition Key.

If interference occurs, Fault Codes may be recorded in the ECM and Immobiliser Module.

Note!

The Mitsubishi MUT III Scan Tool is required to register additional keys in the Immobiliser Module.

During key registration the Vehicle Password also needs to be input.

Inlet Air Temp Sensor

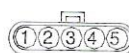
The Inlet Air Temp Sensor is integrated into the Mass Airflow Sensor. This combined sensor is located on the air box assembly. The ECM monitors this sensor to determine intake air temperature.

To Test Voltage:

See ECM Pin #A49 and A70.

To Test Resistance:

Disconnect Connector and measure between Terminals 1 and 2.



- 1 = Intake Air Temp Sensor Ground to ECM Pin #A70
- 2 = Intake Air Temp Sensor Signal to ECM Pin #A49
- 3 = Mass Air Flow Sensor Signal (Amount) to ECM Pin #A50
- 4 = Mass Air Flow Sensor Ground to ECM Pin #A71
- 5 = Engine Control Relay Power Supply

Mitsubishi 4M41 Mass Air Flow Sensor Connector
(Backprobing View From Harness Side)

Temperature	Resistance
20°C	2.3 to 3 k Ohms
40°C	1 to 1.5 k Ohms
80°C	0.31 to 0.43 k Ohms

Instrument Cluster

The Instrument Cluster incorporates:

- Instrument Cluster ECU.
- Malfunction Indicator Lamp (MIL).
- Diesel Particulate Filter (DPF) Lamp.
- Glow Plug Indicator Lamp.
- Water Separator Lamp.
- Cruise Control Indicator Lamp.

Instrument Cluster ECU

The Instrument Cluster ECU is located within the Instrument Cluster. It is at one end of the CAN Communication Bus and contains a terminating resistor (120 Ohms).

The ECM provides data to the Instrument Cluster ECU via the CAN Communication Bus. Control of the various instruments/lamps is performed based on data received on the CAN Bus. Additional instrument controls utilise sensors hard-wired to the Instrument Cluster ECU.

To Test Voltage:

See ECM Pin #B27 and B35.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) is located in the Instrument Cluster. The Instrument Cluster ECU will activate this Lamp based on ECM requests. These requests are provided via the CAN Communication Bus.

To Test Voltage:

See ECM Pin #B27 and B35.

Note!

Should the MIL illuminate (continuous or flashing), this indicates a system fault.

Check ECM for the presence of Fault Codes.

Manifold Absolute Pressure

The Manifold Absolute Pressure Sensor is a piezo resistive element type. It is located on the fuel filter bracket on the left side of the fire wall. This Sensor outputs a voltage proportional to actual manifold pressure (vacuum and boost).

It provides feedback to the ECM during:

- Exhaust Gas Recirculation operation.
- Turbo Boost Control Solenoid operation.

To Test Voltage:

See ECM Pin #A52, A73 and A80.

Manual Gearbox Switches

The 4 Gearbox Switches are situated on the rear section of the main gearbox housing. Three switches are located together on the side of the gearbox housing.

- Reverse Shift Rail Switch (lowest position).
- 3-4 Shift Rail Switch (middle position).
- 1-2 Shift Rail Switch (top position).

The Select Rail Switch is located on its own, on the top surface of the main housing. ECM monitoring of these ON/OFF signals is used to determine shift lever position.

Switch Operation Chart

Gear	Select Rail	1-2 Shift Rail	3-4 Shift Rail	Reverse Shift Rail
First	OFF	ON	OFF	OFF
Second	ON	ON	OFF	OFF
Third	OFF	OFF	ON	OFF
Fourth	ON	OFF	ON	OFF
Fifth/Neutral	OFF	OFF	OFF	OFF
Reverse	ON	OFF	OFF	ON

To Test Voltage:

See ECM Pin #A14, A16, B14 and B15.

Mass Airflow Sensor

The heated resistor type Mass Air Flow Sensor is located on the air box assembly. The Intake Air Temp Sensor is integrated into the Mass Air Flow Sensor.

The ECM monitors this sensor to determine the quantity and speed of intake air. It is also used to provide feedback to the ECM during EGR operation.

To Test Voltage:

See ECM Pin #A50 and A71.

Power Steering Pressure Switch

The Power Steering Pressure Switch is located on the top surface of the Power Steering Pump.

The ECM monitors this switch for power steering load.

To Test Voltage:

See ECM Pin #B6.

Serial Communication

Two different protocols are used on these vehicles for network serial communication:

- High Speed CAN (Controller Area Network) Communication Bus protocol.
- Mitsubishi Smart Wiring System (SWS) Low Speed Network protocol.

The Body Control Module acts as a portal for bi-directional translation between protocols. This ensures data exchange between the different speed networks.

High Speed CAN Communication Bus:

These vehicles use BUS Communication (Bi-Directional Universal Signal).

The Bus consists of a twisted pair wiring to minimise external interference. The serial multiplex protocol used is Controller Area Network (CAN).

This is a high-speed Class C network with real time control functions.

The following modules are connected to the CAN Bus:

- Engine ECM.
- Auto Trans ECM.
- Active Stability and Traction Control (ASTC) System ECM.

- Immobiliser Module.
- Body Control Module.
- G and Yaw Rate Sensor.
- Steering Wheel Sensor.
- Centre Display ECU.
- Supplemental Restraint System ECM.
- Instrument Cluster ECU.
- 16 Pin Diagnostic Connector.

Each module is a "node", being able to send and receive messages. The "terminating nodes" are within the ASTC System ECM and the Instrument Cluster ECU.

The terminating nodes contain a 120 Ohm resistor across each Bus wire to prevent signal corruption.

To Test Voltage:

See ECM Pin #B27 and B35.

Mitsubishi SWS Low Speed Network:

The Low Speed Network is utilised for the comfort and convenience systems.

Bi-directional communication is used between modules.

This is provided by a single wire connecting to each module in parallel.

In addition to the communication wire, an input request signal circuit is included (uni-directional).

This circuit is between the Body Control Module and the Combination Switch ECU.

Starter Relay

The Starter Relay is located in engine bay relay box, next to the battery. It is used to control operation of the starter motor.

To Test Voltage:

See ECM Pin #B13.

Steering Wheel Sensor

The Steering Wheel Sensor is located behind the combination switch. This Sensor is part of the Active Stability and Traction Control (ASTC) System.

It is used to detect the actual steering wheel angle, input by the driver. This is used by the ASTC System when calculating traction control demand.

ECM monitoring of this demand is carried out via the CAN Communication Bus

Based on information received, the ECM may control engine output.

To Test Voltage:

See ECM Pin #B27 and B35.

Suction Control Solenoid

The Suction Control Solenoid is located at the rear of the Fuel Supply Pump Assembly. This Solenoid is not serviced separately from the Fuel Supply Pump.

The ECM varies the Suction Control Solenoid position to manage Fuel Pressure. This results in adjustment of the feed pump supply, to the high pressure pump.

Note!

*If replaced, the fuel supply pump correction value needs to be learnt by the ECM.
This value relates to the Suction Control Solenoid duty cycle, at a specific common rail pressure.
The Mitsubishi MUT III Scan Tool will be necessary for this learn function.*

To Test Voltage:
See ECM Pin #A17 and A37.

To Test Resistance @ 20°C:
Disconnect Connector, measure between terminals:
Should be 2.1 Ohms approx.

Sunroof ECU (If Fitted)

The Sunroof ECU is integrated with the sunroof control motor and hall sensors. This combined assembly is located in the roof lining. It is part of the Mitsubishi Smart Wiring System (SWS) Low Speed Network. Sunroof activation is based on signals received over the SWS Network.

SRS ECM

The Supplemental Restraint System ECM is located behind the centre console, against the floor pan. It is connected to the CAN Communication Bus.

The SRS warning indicator lamp is operated via the CAN Bus.

Swirl Control Actuator

The Swirl Control Actuator is located at the front of the inlet manifold. It is used to open or close the swirl control valves in the inlet manifold. The Swirl Control Solenoid is used by the ECM, to control the vacuum applied to this Actuator. This Actuator forms part of the Swirl Control System.

To Test:

1. Disconnect vacuum supply line.
2. Connect vacuum pump to Actuator.
3. Confirm actuator rod movement when vacuum is applied.

Swirl Control Solenoid

The Swirl Control Solenoid is located on the left side of the rocker cover. This Solenoid is used to control the vacuum source applied to the Swirl Control Actuator. Vacuum applied to the Actuator is stored in the Vacuum Tank. It forms part of the Swirl Control System.

To Test Voltage:
See ECM Pin #A10.

To Test Resistance @ 20°C:
Disconnect connector, measure between Terminals:
Should be 29 to 35 Ohms.

Swirl Control System

The Swirl Control System is used to improve the inlet air swirl effect, during low load conditions. This is achieved by closing the air supply to one inlet valve per cylinder, using the swirl control valves. ECM control of the swirl control valves is performed using the Swirl Control Solenoid.

The System consists of:

- Swirl Control Actuator.
- Swirl Control Solenoid.
- Vacuum Tank (mounted to engine block).
- Swirl Control Valves (within inlet manifold).

Tachometer Signal

The engine speed signal is generated by the ECM. It is based on the Crankshaft Position Sensor input. This signal is then communicated to the other modules via the CAN Communication Bus.

Throttle Body

The electronic Throttle Body is located on the inlet manifold. It incorporates the Throttle Position Sensor and Throttle Valve Servo Motor.

Throttle Position Sensor

The non-contact hall element Throttle Position Sensor is integrated with the throttle body. The ECM monitors this Sensor to determine the amount and rate of throttle valve opening. Activation of the throttle valve is via the Throttle Valve Servo Motor.

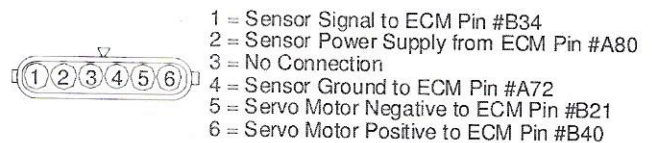
To Test Voltage:
See ECM Pin #A72, A80 and B34.

Throttle Valve Servo Motor

Throttle Valve Servo Motor is integrated with the throttle body. The Servo Motor is driven to a target position by the ECM using current control. The throttle valve is then moved to the desired position. Feedback of throttle valve position is provided by the Throttle Position Sensor.

To Test Voltage:
See ECM Pin #B21 and B40.

To Test Resistance @ 20°C:
Disconnect Throttle Body Connector, measure between Terminals 5 and 6:
Should be 0.3 to 100 Ohms.



Mitsubishi 4M41 Throttle Body Connector
(Backprobing View From Harness Side)

Turbocharger

The Turbocharger is located on the right side of the engine.

Auto Models:

These models use a Variable Vane Turbocharger. Boost pressure is ECM controlled by changing the angle of the variable turbine feed vanes. This angle is varied by the amount of vacuum applied to the Turbocharger Boost Control Actuator.

Manual Models:

These models use a waste-gate controlled, Fixed Vane Turbocharger. Boost pressure is mechanically controlled. This is provided by the Turbo Waste-gate Actuator and Waste-gate Valve.

To Test:

Ensure engine is at normal operating temp (80°C to 90°C).
Engine speed >3,000 RPM under full load in second gear.
Boost pressure should be:

- 177.3 to 195.9 kPa (Auto).
- 178.9 to 188.2 kPa (Manual).

Turbo Boost Actuator (Auto)

The Turbocharger Boost Control Actuator is located at the turbocharger. It is used to change the angle of the variable turbine feed vanes within the turbocharger. This angle is varied by the amount of vacuum applied to the Actuator. The Turbo Boost Control Solenoid is used to modulate the vacuum applied to this Actuator.

To Test:

1. Disconnect vacuum supply line.
2. Connect vacuum pump to Actuator.
3. Gradually increase the applied vacuum.
4. Confirm approx. 1mm of rod movement at vacuum reading of 46.3 to 50 kPa.

Note!

To avoid Actuator damage, do not apply vacuum greater than 58 kPa during test procedure.

Turbo Boost Solenoid (Auto)

The Turbocharger Boost Control Solenoid is located on the right side of the rocker cover. ECM current control of this Solenoid, meters the vacuum applied to the Turbo Boost Control Actuator. This varies the boost pressure in the inlet manifold.

To Test Voltage:

See ECM Pin #A21.

To Test Resistance @ 20°C:

Disconnect connector, measure between Terminals:
Should be 10 to 14 Ohms.

Turbocharger Intercooler

The Turbocharger Intercooler is located behind the front bumper. The incoming air is compressed by the Turbocharger, causing it to become heated.

This air is then cooled by the Intercooler to provide greater volumetric efficiency.

Turbocharger System

A unique Turbocharger System is used for manual and auto models. It incorporates:

Auto Models: These models utilise a variable vane turbocharger, with ECM boost pressure control.

The system consists of:

- Turbocharger Boost Control Actuator.
- Turbocharger Boost Control Solenoid.
- Variable Vane Turbocharger.
- Manifold Absolute Pressure Sensor (boost pressure feedback).
- Turbocharger Intercooler.

Manual Models:

These models use a fixed vane turbocharger with waste-gate control of boost pressure. The system consists of:

- Turbocharger Waste-gate control system.
- Fixed Vane Turbocharger (with waste-gate control).
- Turbocharger Intercooler.
- Manifold Absolute Pressure Sensor (boost pressure monitoring).

Turbo Waste-gate (Manual)

Turbocharger Waste-gate control system is used on manual models. The Waste-gate control is located with the Fixed Vane Turbocharger.

This system is managed mechanically by:

- Turbocharger Waste-gate Actuator.
- Turbocharger Waste-gate Valve (within turbocharger).

Note!

Continual monitoring of boost pressure is provided by the ECM. Should an over-boost condition be detected, ECM intervention will occur to restrict engine output.

To Test:

1. Disconnect vacuum supply line.
2. Connect vacuum pump to Actuator.
3. Gradually increase the applied vacuum.
4. Confirm approx. 1mm of rod movement at vacuum reading of 118.8 to 124.2 kPa.

Note!

To avoid Actuator damage, do not apply vacuum greater than 152 kPa during test procedure

Vehicle Speed Sensor

The Vehicle Speed Sensor is located on the left side of the transmission extension housing. The ECM monitors this sensor as part of the overall vehicle speed calculation.

To Test Voltage:

See ECM Pin #B29.

Water Separator Lamp

The Water Separator Lamp is located in the Instrument Cluster. It is activated by the Instrument Cluster ECU. This is based upon the Water Separator Switch input.

Water Separator Switch

The Water Separator Switch is situated at the base of the Fuel Filter Assembly, at the fire wall. It is used to alert the driver should the water level within the filter become excessive. It is used to alert the driver of an excessive water level within the filter.

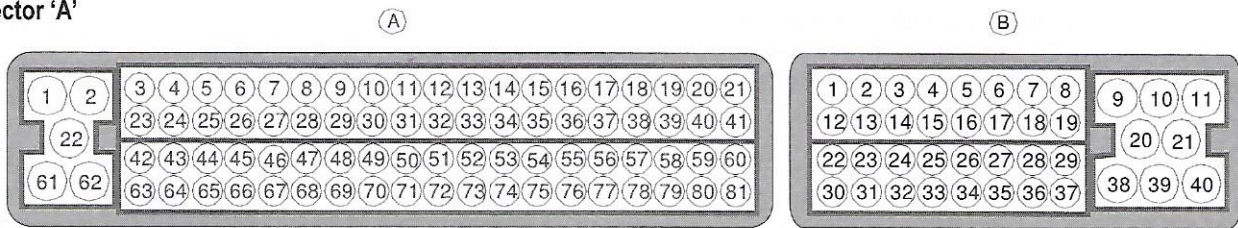
Warnings

The Fuel Injectors operate at up to 100 Volts approx. Ensure ignition is OFF before touching or disconnecting injector wiring.

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running. Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes

ECM Voltage Table

Connector 'A'

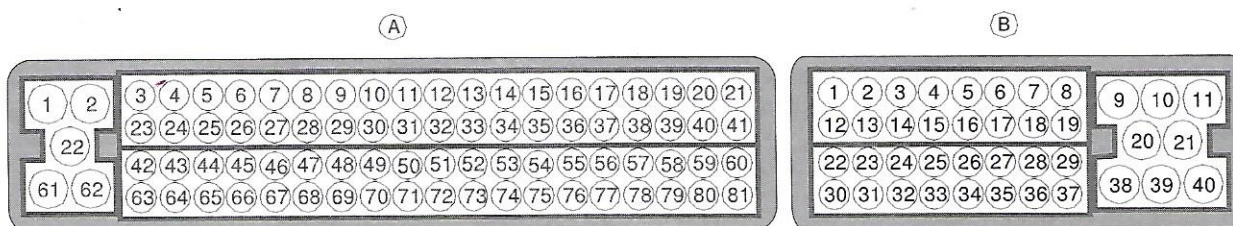


Mitsubishi Pajero 4M41 Turbo Diesel ECM Connector 'A' (Backprobing View)

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
A1	Power Supply, Fuel Injector #1 and 4 No Specification Available	N/A	A23	Fuel Injector #1 Control No Specification Available	N/A
A2	Power Supply, Fuel Injector #2 and 3 No Specification Available	N/A	A24	Fuel Injector #1 Control No Specification Available	N/A
A3	Fuel Injector #3 Control No Specification Available	N/A	A25	Fuel Injector #4 Control No Specification Available	N/A
A4	Fuel Injector #3 Control No Specification Available	N/A	A26	Fuel Injector #4 Control No Specification Available	N/A
A5	Fuel Injector #2 Control No Specification Available	N/A	A29	Glow Plug Relay Control Engine Coolant Temp <60°C Glow Plugs ON	<1 Volt
A6	Fuel Injector #2 Control No Specification Available	N/A		Engine Coolant Temp >60°C Glow Plugs OFF	Battery Volts
A7	ATCP Module (If Fitted) Bus Line Positive	Data Stream	A34	Brake Light Switch (Normally Open Switch) Ignition ON	<1 Volt
A8	ATCP Module (If Fitted) Bus Line Negative	Data Stream		Brake Pedal Released	<1 Volt
A10	Swirl Control Solenoid Ignition ON, Engine Running After Warm Up @ 4,000RPM	Battery Volts Voltage Decreases		Brake Pedal Depressed	Battery Volts
A13	Air Conditioner Load Signal Engine Idling, After Warm Up with A/C ON A/C Compressor Operating A/C Compressor Not Operating	<1 Volt to Battery Volts Pulse <1 Volt	A37	Suction Control Valve (Negative) Engine Idling	Voltage Pulse
A14	Select Rail Switch (Manual) Ignition ON Gear Lever in Second, Fourth or Reverse Position Other Position Selected	Battery Volts <1 Volt	A39	A/C Condenser Fan Relay Control Ignition ON Air Conditioner OFF Engine Coolant Temp <95°C Engine Running with A/C ON Vehicle Speed <60 km/h	Battery Volts Battery Volts <1 Volt
A15	Air Conditioner System ECU Air Conditioner ON A/C Compressor Operating Air Conditioner OFF	Battery Volts <1 Volt	A40	Air Conditioner Compressor Relay Control Engine Idling with A/C ON A/C Compressor Not Operating A/C Compressor Operating	Battery Volts <1 Volt
A16	3-4 Shift Rail Switch Ignition ON Gear Lever in Third or Fourth Position Other Position Selected	Battery Volts <1 Volt	A43	Cruise Control Switch Signal Ignition ON All Switches OFF ON/OFF (MAIN) Switch ON CANCEL Switch ON COAST/SET Switch ON ACC/RES Switch ON	4.7 to 5 Volts 0 to 0.5 Volts 1 to 1.8 Volts 2.3 to 3 Volts 3.5 to 4.2 Volts
A17	Suction Control Valve (Positive) Engine Idling	Voltage Pulse	A44	Engine Bay Temp Sensor (Auto) Ignition ON Engine Bay Ambient Temp @ 20°C Engine Bay Ambient Temp @ 40°C Engine Bay Ambient Temp @ 80°C	2.1 to 2.7 Volts 1.2 to 1.8 Volts 0.2 to 0.8 Volts
A19	EGR Valve Servo Motor (Positive) Engine After Warm Up Idling @ 3,500 RPM	1 to 3 Volts approx. <1 Volt	A46	Exhaust Differential Pressure (DP) Sensor (Auto) Hoses Disconnected Apply Pressure to One Side of Sensor	<1 Volt Proportional Voltage Change
A20	EGR Valve Servo Motor (Negative) Engine After Warm Up Idling @ 3,500 RPM	1 to 3 Volts approx. <1 Volt	A47	Exhaust Temp Sensor #2 (Auto) Engine Idling After Warm Up Catalyst Temp @ 200°C Catalyst Temp @ 400°C Catalyst Temp @ 800°C	4 to 4.6 Volts 2.4 to 3 Volts 0.5 to 1.1 Volts
A21	Turbo Boost Control Solenoid (Auto) Ignition ON Increasing Engine Speed Engine Idling	Battery Volts Proportional Voltage Change 45 to 55% Duty Cycle	A48	Exhaust Temp Sensor #1 (Auto) Engine Idling After Warm Up Exhaust Gas Temp @ 200°C Exhaust Gas Temp @ 400°C Exhaust Gas Temp @ 800°C	4 to 4.6 Volts 2.4 to 3 Volts 0.5 to 1.1 Volts
A22	Ground All Times	Low Volts			

Pin #	Circuit and Status	Voltage
A49	Intake Air Temp Sensor Signal (In Mass Airflow Sensor) Ignition ON Intake Air Temperature @ 20°C Intake Air Temperature @ 40°C Intake Air Temperature @ 80°C	2.1 to 2.7 Volts 1.2 to 1.8 Volts 0.2 to 0.8 Volts
A50	Mass Airflow Sensor Signal Engine Running Gradually Increase Engine Speed	Increasing Voltage
A51	EGR Valve Position Sensor Signal Engine Running After Warm Up, Idling @ 3,500RPM	>2 Volts <1.5 Volts
A52	Manifold Absolute Pressure Sensor Signal Ignition ON Increasing Engine Speed	0.7 to 1.2 Volts Increasing Voltage
A53	Engine Coolant Temp Sensor Signal Ignition ON Coolant Temperature @ 20°C Coolant Temperature @ 40°C Coolant Temperature @ 80°C	3.3 to 3.9 Volts 2.4 to 3 Volts 0.9 to 1.5 Volts
A54	Fuel Temp Sensor Signal Ignition ON Fuel Temperature @ 20°C Fuel Temperature @ 40°C Fuel Temperature @ 80°C	2.1 to 2.7 Volts 1.2 to 1.8 Volts 0.2 to 0.8 Volts
A56	Fuel Pressure Sensor Signal Engine Idling After Warm Up	1.15 to 1.75 Volts
A57	Camshaft Position Sensor Signal Engine Cranking or Idling	0 to 5 Volts Pulses
A58	Crankshaft Position Sensor Signal Engine Cranking or Idling	0 to 5 Volts Pulses
A59	Camshaft Position Sensor Power Supply Ignition ON	4.9 to 5.1 Volts
A60	Crankshaft Position Sensor Power Supply Ignition ON	4.9 to 5.1 Volts
A61	Ground All Times	Low Volts

Pin #	Circuit and Status	Voltage
A63	Exhaust Pressure Sensor (Auto) Pressure @ 60 kPa Pressure @ 100 kPa Pressure @ 200 kPa	1.8 to 2.0 Volts 2.5 to 2.7 Volts 4.4 to 4.6 Volts
A65	Boost Air Temp Sensor Signal Ignition ON Boost Inlet Air Temperature @ 20°C Boost Inlet Air Temperature @ 40°C Boost Inlet Air Temperature @ 80°C	2.1 to 2.7 Volts 1.2 to 1.8 Volts 0.3 to 0.9 Volts
A66	Cruise Control Switch Ground All Times	Low Volts
A67	Sensor Ground (Exhaust Pressure/ DP Sensors) (Auto) All Times	Low Volts
A68	Exhaust Temp Sensor #2 Ground (Auto) All Times	Low Volts
A69	Sensor Ground (Auto) All Times	Low Volts
A70	Intake Air Temp Sensor Ground All Times	Low Volts
A71	Mass Airflow Sensor Ground All Times	Low Volts
A72	Sensor Ground All Times	Low Volts
A73	Manifold Absolute Pressure Sensor Ground All Times	Low Volts
A74	Engine Coolant Temp Sensor Ground All Times	Low Volts
A75	Sensor Ground All Times	Low Volts
A76	Fuel Pressure Sensor Ground All Times	Low Volts
A78	Camshaft Position Sensor Ground All Times	Low Volts
A79	Crankshaft Position Sensor Ground All Times	Low Volts
A80	Sensor Power Supply Ignition ON	4.9 to 5.1 Volts
A81	Fuel Pressure Sensor Power Supply Ignition ON	4.9 to 5.1 Volts



Mitsubishi Pajero 4M41 Turbo Diesel ECM Connector 'A' (Backprobing View)

Connector 'B'

Pin #	Circuit and Status	Voltage
B2	Ignition ON Power Supply Ignition ON	Battery Volts
B4	Brake Light Switch (Normally Closed Switch) Ignition ON Brake Pedal Released Brake Pedal Depressed	<1 Volts Battery Volts
B5	Clutch Switch (Manual) Ignition ON Clutch Pedal Released Clutch Pedal Depressed	Battery Volts <1 Volts
B6	Power Steering Pressure Switch Engine Idling Steering Wheel @ Rest Steering Wheel Turning	Battery Volts <1 Volts

Pin #	Circuit and Status	Voltage
B9	ECM Power Supply Ignition ON	Battery Volts
B10	ECM Power Supply Ignition ON	Battery Volts
B11	ECM Backup Power Supply (Battery Monitor) All Times	Battery Volts
B13	Start Signal Engine Cranking	>8 Volts
B14	1-2 Shift Rail Switch Ignition ON Gear Lever in First or Second Position Other Position Selected	Battery Volts <1 Volts
B15	Reverse Light Shift Switch Ignition ON Gear Lever in Reverse Position Other Position Selected	Battery Volts <1 Volts

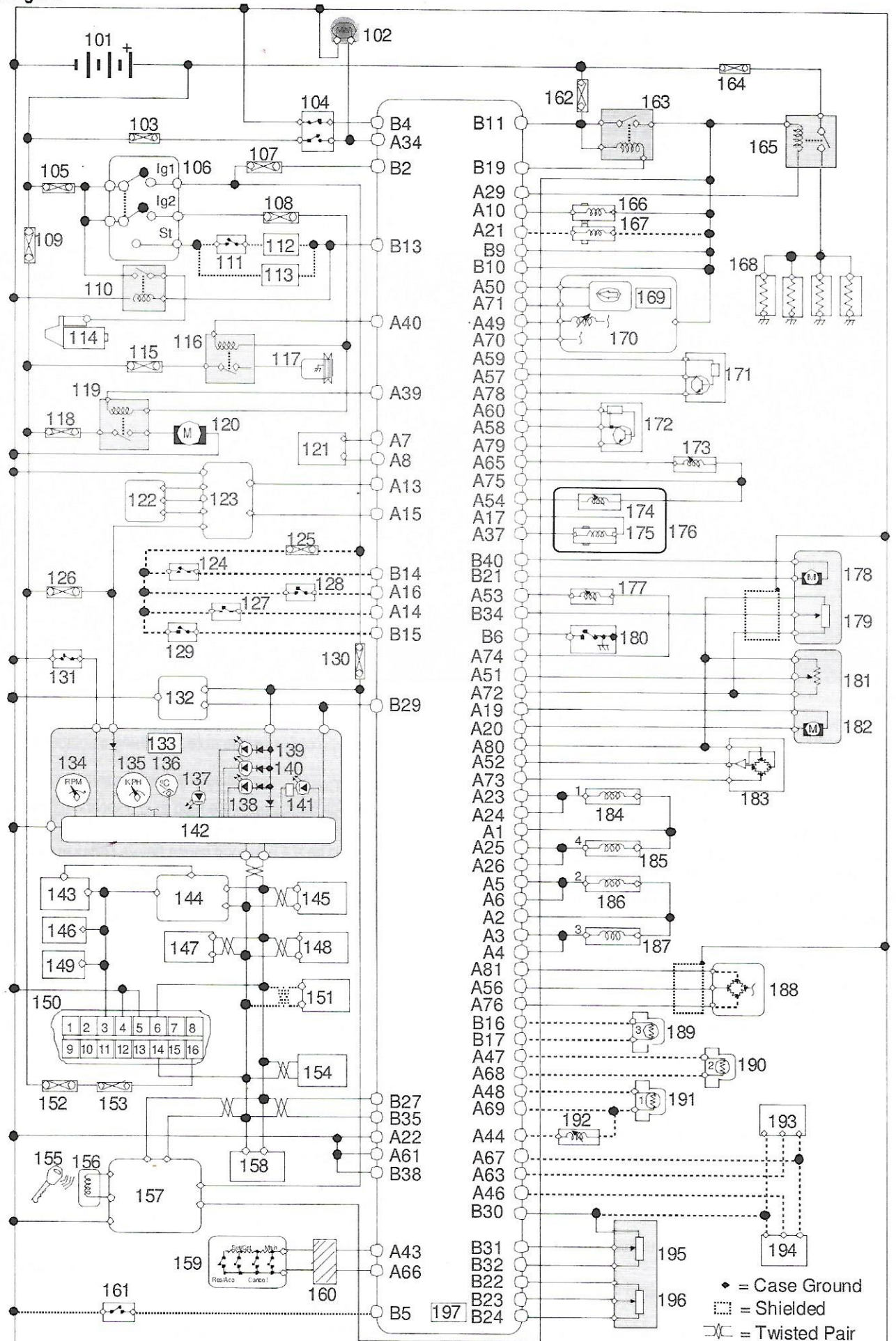
Connector 'B' (cont.)

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
B16	Exhaust Temp Sensor #3 (Auto) Engine Idling After Warm Up DPF Temperature @ 200°C DPF Temperature @ 400°C DPF Temperature @ 800°C	4 to 4.6 Volts 2.4 to 3 Volts 0.5 to 1.1 Volts	B29	Vehicle Speed Sensor Ignition ON Vehicle Moving Forward Slowly	0 to 5 Volts Pulses
B17	Exhaust Temp Sensor #3 Ground All Times	Low Volts	B30	Sensor Power Supply Ignition ON	4.9 to 5.1 Volts
B19	Engine Control Relay Ignition OFF Ignition ON	Battery Volts <1 Volts	B31	Accelerator Pedal Position Sensor (Main) Signal Ignition ON Accelerator Pedal Released Accelerator Pedal Fully Depressed	0.7 to 1.3 Volts >4 Volts
B21	Throttle Valve Servo Motor (Negative) Engine Idling Within 3 Seconds of Engine Shut Down (Fully Closed Throttle)	Battery Volts approx. Voltage Decrease	B32	Accelerator Pedal Position Sensor (Main) Ground All Times	Low Volts
B22	Accelerator Pedal Position Sensor (Sub) Power Supply Ignition ON	2.4 to 2.6 Volts	B34	Throttle Position Sensor Signal Ignition ON Throttle Valve Servo Motor Disabled Throttle Valve @ Fully Closed Position Throttle Valve @ Wide Open Position	0.3 to 0.7 Volts >4 Volts
B23	Accelerator Pedal Position Sensor (Sub) Signal Ignition ON Accelerator Pedal Released Accelerator Pedal Fully Depressed	0.2 to 0.8 Volts >2 Volts	B35	CAN Communication Low Bus Line Ignition ON During Data Transmission	1 to 4 Volts approx. Serial Data
B24	Accelerator Pedal Position Sensor (Sub) Ground All Times	Low Volts	B38	Ground All Times	Low Volts
B27	CAN Communication High Bus Line Ignition ON During Data Transmission	1 to 4 Volts approx. Serial Data	B40	Throttle Valve Servo Motor (Positive) Engine Idling Within 3 Seconds of Engine Shut Down (Fully Closed Throttle Valve)	Battery Volts approx. Voltage Decrease

Key to Wiring Diagram (next page)

101. Battery	135. Speedometer	169. Mass Airflow Sensor
102. Brake Lights	136. Engine Temperature Gauge	170. Inlet Air Temp Sensor
103. Fuse 16 (15Amp) – Engine Bay	137. Diesel Particulate Filter Lamp	171. Camshaft Position Sensor
104. Brake Light Switch	138. Water Separator Lamp	172. Crankshaft Position Sensor
105. Fusible Link 3 (40Amp) – Engine Bay	139. Malfunction Indicator Lamp	173. Boost Air Temp Sensor
106. Ignition Switch	140. Glow Plug Indicator Lamp	174. Fuel Temp Sensor
107. Fuse 8 (7.5Amp) - Interior JB	141. Cruise Control Indicator Lamp	175. Suction Control Solenoid
108. Fuse 5 (7.5Amp) - Interior JB	142. Instrument Cluster ECU	176. Fuel Supply Pump Assembly
109. Fusible Link 1 (140Amp) – Engine Bay	143. Combination Switch ECU	177. Engine Coolant Temp Sensor
110. Starter Relay	144. Body Control Module	178. Throttle Valve Servo Motor
111. Auto Trans Inhibitor Switch	145. G And Yaw Rate Sensor	179. Throttle Position Sensor
112. Inhibitor Switch Circuit (Auto)	146. Sunroof ECU (If Fitted)	180. Power Steering Pressure Switch
113. Starter Circuit (Manual)	147. Centre Display ECU	181. EGR Valve Position Sensor
114. Starter Motor	148. Supplemental Restraint System ECM	182. EGR Valve Servo Motor
115. Fuse 19 (10Amp) – Engine Bay	149. Front (Engine Bay) ECU	183. Manifold Absolute Pressure Sensor
116. Air Conditioner Compressor Relay	150. 16 Pin Diagnostic Connector	184. Fuel Injector #1
117. Air Conditioner Compressor	151. Auto Trans ECM	185. Fuel Injector #4
118. Fuse 10 (25Amp) – Engine Bay	152. Fusible Link 2 (60Amp) – Engine Bay	186. Fuel Injector #2
119. A/C Condenser Fan Relay (If Fitted)	153. Fuse 15 (15Amp) - Interior JB	187. Fuel Injector #3
120. Air Conditioner Condenser Fan	154. Steering Wheel Sensor	188. Fuel Pressure Sensor
121. ATCP Module (If Fitted)	155. Ignition Key Transponder	189. Exhaust Temp Sensor #3 (Auto)
122. Air Conditioner Pressure Sensor	156. Ignition Lock Antenna	190. Exhaust Temp Sensor #2 (Auto)
123. Air Conditioner System ECU	157. Immobiliser Module	191. Exhaust Temp Sensor #1 (Auto)
124. 1-2 Shift Rail Switch (Manual)	158. ASTC System ECM	192. Engine Bay Temp Sensor (Auto)
125. Fuse 3 (7.5Amp) - Interior JB	159. Cruise Control Switch	193. Exhaust Pressure Sensor (Auto)
126. Fuse 18 (15Amp) – Engine Bay	160. Clock Spring	194. Exhaust Differential Pressure (DP) Sensor (Auto)
127. Select Rail Switch (Manual)	161. Clutch Switch (Manual)	195. Accelerator Pedal Position Sensor (Main)
128. 3-4 Shift Rail Switch (Manual)	162. Fusible Link 5 (20Amp) – Engine Bay	196. Accelerator Pedal Position Sensor (Sub)
129. Reverse Shift Rail Switch (Manual)	163. Engine Control Relay	197. Engine Control Module (ECM)
130. Fuse 2 (7.5Amp) - Interior JB	164. Fusible Link 33 (80Amp) – Battery	
131. Water Separator Switch	165. Glow Plug Relay	
132. Vehicle Speed Sensor	166. Swirl Control Solenoid	
133. Instrument Cluster	167. Turbo Boost Control Solenoid (Auto)	
134. Tachometer	168. Glow Plugs	

Wiring Diagram



Mitsubishi Pajero 4M41 Turbo Diesel Engine Management System

Manufacturer: TOYOTA

Application: HI-LUX 2005-08, PRADO 2006 -08
3.0L Diesel (1KD-FTV Engine)

Subject: Engine Management System

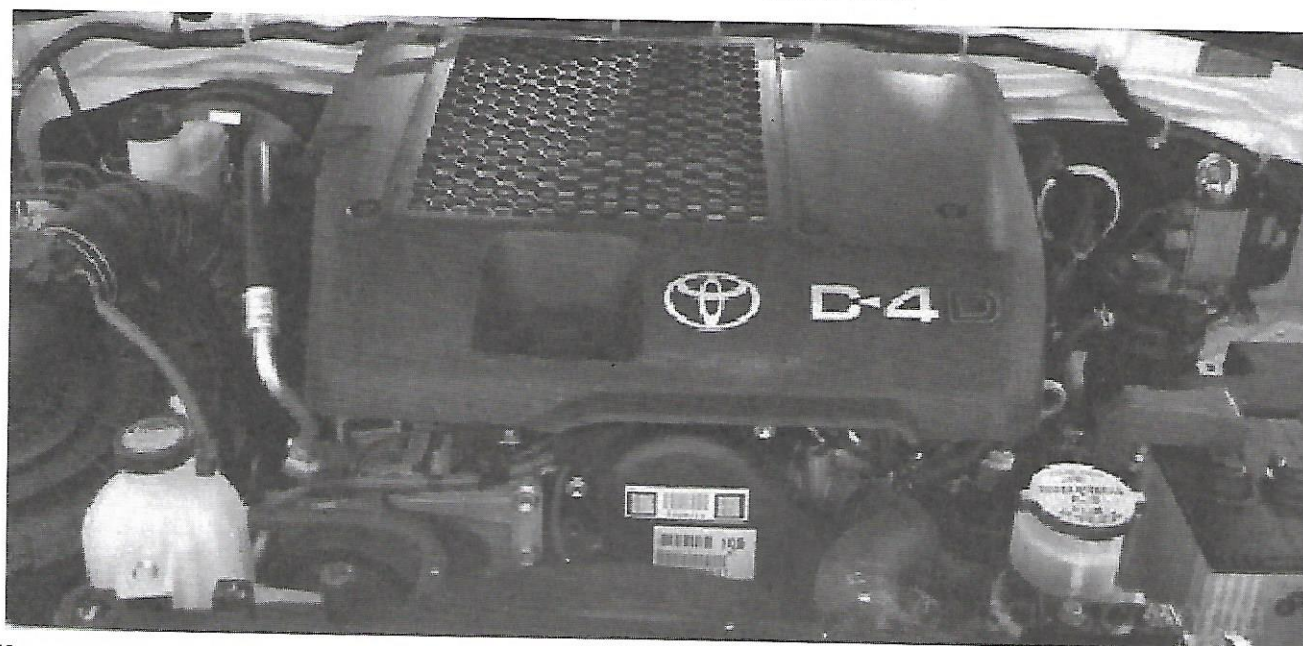
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Overview

These vehicles are fitted with the 3.0L 1KD-FTV electronically controlled common rail diesel engine.

The following are all electronically controlled:

- Glow Plug Control.
- Exhaust Gas Recirculation.
- Fuel Injector Operation.
- Fuel Pressure.
- PCV Operation.
- Throttle Operation.
- Turbocharger Boost.
- Variable Intake.



ECM

The ECM is located behind the glove box. Should the ECM require replacement, Fuel Injector Compensation Codes must be input into the replacement ECM. This requires the use of the Toyota Intelligent Tester or equivalent tester.

ECM Initialisation

Should the engine fail to start or stall immediately after startup, the ECM may have lost its learned values and ECM Initialisation may be required. The ECM can be initialized through the intelligent tester or manually.

Manual Initialisation:

1. Bridge Diagnostic Connector terminal 13 (TC) to terminal 4 (ground).
2. Switch ignition ON.
3. Wait 3 minutes, then switch ignition OFF.
4. Remove bridge from Diagnostic Connector.
5. Start engine and allow to idle.

Note!

Do not race engine immediately after starting engine (acceptable after engine has idled).

If the engine cannot be started, repeat the initialization procedures from the beginning.

6. Idle engine for at least 1 minute under the following conditions:
 - Coolant temperature >6°C (can be estimated by touching the outlet hose).
 - Fuel temperature >20°C (use ambient air temperature as a guide).

Fault Codes

Fault Codes are available as OBDII or 2 digit manual type. OBDII type codes can be accessed using a compatible scan tool.

Manual Codes:

The 2 digit Fault Codes are read as 0.5 second flashes of the Malfunction Indicator Lamp (MIL).

There will be a 4.5 second pause before codes are output.

There will be a 1.5 second pause between the tens and units.

There will be a 2.5 second pause between codes.

Should there be more than one code in memory, they will be displayed in ascending order. The codes will be repeated.

The letter 'A' in the table indicates 10 flashes of the light.

Fault Code Extraction

OBDII type Fault Codes can be extracted using a compatible scan tool.

Manual 2 digit codes can be extracted as follows:

Switch ignition ON.

Bridge Diagnostic Connector terminal 13 to ground.

Read codes as flashes of the Malfunction Indicator Lamp.

Diagnostic Connector

The 16 pin OBDII type Diagnostic Connector is located under the driver side dash.

Scan tools can be connected to this connector for diagnosis.

To Test Voltage:

See ECM Pin #A11, A18 and A19.

Fault Code Identification (OBDII Codes)

Code #	Fault	Code #	Fault
P0045	Turbocharger / Supercharger Boost Control Solenoid Circuit Open	P0192	Fuel Rail Pressure Low Input
P0087	Fuel Rail System Pressure Too Low	P0193	Fuel Rail Pressure High Input
P0088	Fuel Rail System Pressure Too High	P0200	Injector Circuit Malfunction
P0093	Fuel System Leak Detected (Large)	P0234	Engine Overboost Condition
P0095	Intake Air Temperature Sensor 2 Circuit Malfunction	P0299	Engine Underboost Condition
P0097	Intake Air Temperature Sensor 2 Circuit Low	P0335	Crankshaft Position Sensor A Malfunction
P0098	Intake Air Temperature Sensor 2 Circuit High	P0339	Crankshaft Position A Sensor Intermittent
P0100	Mass Air Flow Meter or Volume Air Flow Meter Circuit Malfunction	P0340	Camshaft Position Sensor Malfunction
P0102	Mass Air Flow Meter or Volume Air Flow Meter Circuit Low Input	P0488	EGR Throttle Position Control Range / Performance
P0103	Mass Air Flow Meter or Volume Air Flow Meter Circuit High Input	P0500	Vehicle Speed Sensor Malfunction
P0105	Manifold Absolute Pressure Sensor / Barometric Air Pressure Sensor Circuit Malfunction	P0504	Brake Switch A and B Correlation
P0107	Manifold Absolute Pressure Sensor / Barometric Air Pressure Sensor Circuit Low Input	P0606	Control Module Processor Fault
P0108	Manifold Absolute Pressure Sensor / Barometric Air Pressure Sensor Circuit High Input	P0607	Control Module Performance
P0110	Intake Air Temperature Sensor Circuit Malfunction	P0627	Fuel Pump Control Circuit Open
P0112	Intake Air Temperature Sensor Circuit Low Input	P1229	Fuel Pump System Malfunction
P0113	Intake Air Temperature Sensor Circuit High Input	P1251	Stepper Motor for Turbocharger Control Circuit Intermittent
P0115	Engine Coolant Temperature Sensor Circuit Malfunction	P1601	Injector Compensation Code
P0117	Engine Coolant Temperature Sensor Circuit Low Input	P1611	Run Pulse Malfunction
P0118	Engine Coolant Temperature Sensor Circuit High Input	P2008	Intake Manifold Runner Control Circuit Open
P0120	Electronic Throttle Control Motor Range / Performance Problem or Throttle Position Sensor A Circuit Malfunction	P2120	Throttle/Pedal Position Sensor/Switch "D" Circuit Malfunction
P0122	Accelerator Pedal Position Sensor or Throttle Position Sensor A Circuit Low Input	P2121	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance
P0123	Accelerator Pedal Position Sensor or Throttle Position Sensor A Circuit High Input	P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input
P0168	Fuel Temperature Too High	P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input
P0180	Fuel Temp Sensor A Circuit Malfunction	P2125	Throttle/Pedal Position Sensor/Switch "E" Circuit Malfunction
P0182	Fuel Temp Sensor A Low Input	P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input
P0183	Fuel Temp Sensor A High Input	P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input
P0190	Fuel Rail Pressure Circuit Malfunction	P2138	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation
		P2226	Barometric Air Pressure Sensor Circuit Malfunction
		P2228	Barometric Air Pressure Sensor Circuit Low Input
		P2229	Barometric Air Pressure Sensor Circuit High Input
		U0001	High Speed CAN Communication Bus Malfunction

Fault Code Identification (Manual Codes)

Code #	Fault	Code #	Fault
12	Crankshaft or Camshaft Position Sensor Malfunction	17	Run Pulse Malfunction
13	Crankshaft Position A Sensor Intermittent	19	Throttle/Pedal Position Sensor/Switch "D" Circuit Malfunction
15	EGR Throttle Position Control Range / Performance	22	Engine Coolant Temperature Sensor Circuit Malfunction

Code #	Fault
23	Intake Air Temperature Sensor 2 Circuit Malfunction
24	Intake Air Temperature Sensor Circuit Malfunction
31	Mass Air Flow Meter or Volume Air Flow Meter Circuit Malfunction
34	Turbocharger Boost Control Circuit Malfunction
35	Manifold Absolute Pressure Sensor / Barometric Air Pressure Sensor Circuit Malfunction
39	Fuel Temp Sensor A Circuit Malfunction
41	Electronic Throttle Control Motor Range / Performance Problem or Throttle Position Sensor A Circuit Malfunction

Accelerator Pedal Position Sensor

The Accelerator Pedal Position Sensor is located at the accelerator pedal. The ECM monitors this sensor for driver demand.

To Test Voltage:

See ECM Pin #A22, A23, A26, A27, A28 and A29.

Automatic Transmission Control Module (TCM)

The Automatic Transmission Control Module is located behind the glove box. The ECM communicates with the TCM via serial data.

To Test Voltage:

See ECM Pin #B21 and B22.

Barometric Air Pressure Sensor

The Barometric Air Pressure Sensor is incorporated within the ECM.

Brake Switch

The Brake Switch is located at the pedal cluster. As well as the normally open brake lamp contacts, it incorporates a set of normally closed contacts. The ECM monitors both sets of contacts to determine when the brakes have been applied.

To Test Voltage:

See ECM Pin #B14 and B15.

Camshaft Position Sensor

The Camshaft Position Sensor is located at the front of the auxiliary drive shaft. The ECM monitors this sensor for cylinder identification.

To Test Voltage:

See ECM Pin #C23 and C31.

To Test Resistance @ 20°C:

Disconnect connector and measure between terminals:
Should be 0.95 to 1.25 k Ohms.

Crankshaft Position Sensor

The Crankshaft Position Sensor is located at the lower right front of the engine. Access is from beneath the vehicle.
The ECM monitors this sensor to determine engine speed.

To Test Voltage:

See ECM Pin #D27 and D34.

Code #	Fault
42	Vehicle Speed Sensor Malfunction
49	Fuel Rail System Pressure Malfunction
51	Brake Switch A and B Correlation
58	Intake Manifold Runner Control Circuit Open
78	Fuel Pump System Malfunction
89	Control Module Performance / Injector Compensation Code
97	Injector Circuit Malfunction
A2	High Speed CAN Communication Bus Malfunction
A5	Barometric Air Pressure Sensor Circuit Malfunction

To Test Resistance @ 20°C:

Disconnect connector and measure between terminals - should be 1.85 to 2.45 k Ohms.

Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor is located at the right front of the engine. The ECM monitors this sensor to determine the temperature of the coolant.

To Test Voltage:

See ECM Pin #D19 and D28.

To Test Resistance:

Disconnect connector and measure between terminals:

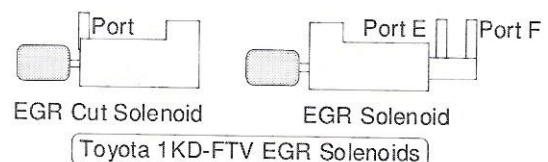
Temperature	Resistance
20°C	2.32 to 2.59 k Ohms
80°C	0.31 to 0.326 k Ohms

Exhaust Gas Recirculation Solenoids

The ECM controls the volume of exhaust gas recirculated to suit all conditions through the Exhaust Gas Recirculation Solenoid and Exhaust Gas Recirculation Cut Solenoid. This reduces combustion temperatures and lowers exhaust emissions.

To Test Voltage:

See ECM Pin #C9 and C18.



To Test:

Disconnect connectors.

EGR Cut Solenoid:

Air should NOT pass from the port to the air filter.

Apply battery voltage to the terminals - air should now pass from the Port to the air filter.

Check resistance between terminals is 37 to 44 Ohms.

EGR Solenoid:

Air should NOT pass from Port E to Port F.

Apply battery voltage to the terminals - air should now pass from Port E to Port F.

Check resistance between terminals is 11 to 13 Ohms.

Fuel Injectors

The Fuel Injectors are located in the cylinder head.
They are ECM operated through the Injector Drive Unit.
The ECM also monitors a feedback signal for confirmation.
Should an injector be replaced, the Fuel Injector Compensation Code must be input into the ECM.

To Test Voltage:

See ECM Pin #D21, D22, D23, D24 and D25.

To Test Resistance @ 20°C:

Test individually - should be 0.85 to 1.05 Ohms.

Fuel Injector Compensation Code

The compensation code is a unique, 30 digit, alphanumeric value printed on the head of the injector.

Should an injector be replaced, the injector's compensation code must be input into the ECM.

Should the ECM be replaced, all of the existing compensation codes must be input into the new ECM. This requires the use of the Toyota Intelligent Tester or equivalent tester.

Note!

If an incorrect code is input into the ECM

- The engine may rattle.
- Engine idle may become rough.
- Engine life may be shortened.
- Engine failure may occur.

Fuel Pressure

Fuel Pressure is limited by the Pressure Limiter on the common rail. Operating pressure is controlled by the ECM.

The ECM commands the Suction Control Valve on the inlet of the Fuel Pump. This adjusts the inlet orifice thereby controlling the availability of fuel and the resultant pressure.

Fuel Pressure Sensor

The Fuel Pressure Sensor is located at the common rail

The ECM monitors this sensor to determine the fuel pressure.

To Test Voltage:

See ECM Pin #D18, D26 and D28.

Fuel Pump

The mechanical Fuel Pump is located at the left front of the engine. Pressurised fuel is supplied to the common rail and from there to each Fuel Injector. Fuel Pressure is ECM controlled by the Suction Control Valve limiting the inlet orifice of the pump.

Fuel Temperature Sensor

The Fuel Temperature Sensor is located at the rear of the Fuel Pump. The ECM monitors this sensor to determine the temperature of the fuel.

To Test Voltage:

See ECM Pin #D29.

To Test Resistance:

Disconnect connector and measure between terminals:

Temperature	Resistance
20°C	2.32 to 2.59 k Ohms
80°C	0.31 to 0.326 k Ohms

Fuse Locations

The following Fuses are located in the main fuse / relay box in the engine compartment.

Fuse AM2 - 30 Amp

Fuse Batt P/I - 50 Amp

Fuse EFI - 25 Amp

Fuse Glow - 80 Amp

The following Fuses are located in the passenger compartment fuse / relay box.

Fuse ECUlg & Gauge 10 Amp

Fuse Ign - 7.5 Amp

Fuse Met 7.5 Amp

Fuse OBD 7.5 Amp

Fuse St - 7.5 Amp

Fuse Stop - 10 Amp

Glow Indicator Lamp

The Glow Indicator Lamp is located in the instrument panel.

The ECM actuates this lamp when the Glow Plugs are operating.

To Test Voltage:

See ECM Pin #A14.

Glow Operation

The ECM actuates the Glow Relay to operate the Glow Plugs when cranking. Dependant upon the coolant temperature, the ECM may perform an "after glow" operation.

At temperatures below 30°C, the "after glow" period is 120 seconds. This period reduces proportionally to temperature and stops when the temperature reaches 40°C.

When the engine is cold, "after glow" reduces diesel knock, white smoke emissions and engine noise.

Glow Plugs

The Glow Plugs are located in the cylinder head.

The ECM controls operation of the Glow Plugs through the Glow Relay.

To Test Resistance @ 20°C:

Test individually - should be 0.95 Ohms.

Glow Relay

The Glow Relay is located in the main fuse / relay box in the engine compartment. The ECM actuates this relay to control operation of the Glow Plugs.

To Test Voltage:

See ECM Pin #A15.

Idle Speed (Base)

Idle Speed is computer controlled and is not adjustable:

Should be 700 to 800 RPM.

Inhibitor Switch (Auto)

The Inhibitor Switch is incorporated with the Automatic Transmission Range Selector. It prevents the engine from starting unless the transmission is in the park or neutral positions.

To Test Voltage:

See ECM Pin #A6 and A7.

Injection Timing

Injection Timing is computer controlled and is not adjustable.

Injector Driver Unit (EDU)

The Injector Driver Unit is located behind the glove box. Acting on commands from the ECM, the EDU controls operation of the Fuel Injectors.

To Test Voltage:

See ECM Pin #D21, D22, D23, D24 and D25.

Injector Driver (EDU) Relay

The Injector Driver (EDU) Relay is located in the main fuse / relay box in the engine compartment. It is incorporated into the Integration Relay with the Main Relay. It provides power to the Injector Drive Unit (EDU).

To Test Voltage:

See ECM Pin #A10.

Inlet Air Temperature Sensor

The Inlet Air Temperature Sensor is located at the left side of the aftercooler. The ECM monitors this sensor to determine the temperature of the air charge.

To Test Voltage:

See ECM Pin #D20 and D28.

To Test Resistance @ 20°C:

Disconnect connector and measure between terminals:
Should be 2.21 to 2.65 k Ohms.

Intake Air Temperature Sensor

The Intake Air Temperature Sensor is incorporated with the Mass Air Flow Meter. The ECM monitors this sensor to determine the temperature of the incoming air.

To Test Voltage:

See ECM Pin #D28 and D31.

To Test Resistance:

Temperature	Resistance
20°C	2.21 to 2.69 k Ohms
80°C	0.49 to 0.67 k Ohms

Intake Manifold Swirl Control Valve

The Intake Manifold Swirl Control Valve is located at the intake manifold. The ECM controls the swirl of the intake air through this valve.

To Test Voltage:

See ECM Pin #D15.

Integration Relay

The Integration Relay is located in the main fuse / relay box in the engine compartment. It incorporates the EDU Relay and the Main Relay.

Main Relay

The Main Relay is located in the main fuse / relay box in the engine compartment. It is incorporated into the Integration Relay with the EDU Relay.

To Test Voltage:

See ECM Pin #A8.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp is located in the instrument panel. This lamp will illuminate when the ignition is switched on. It should extinguish after the engine starts.

To Test Voltage:

See ECM Pin #A12.

Mass Air Flow Meter

The Mass Air Flow Meter is located at the top of the air filter. It incorporates the Intake Air Temperature Sensor.

To Test Voltage:

See ECM Pin #C24 and C32 and ECM Pin #D28 and D31.

Starter Relay

The Starter Relay is located in the main fuse / relay box in the engine compartment.

To Test Voltage:

See ECM Pin #A6 and A7.

Suction Control Valve

The Suction Control Valve is located at the inlet orifice of the Fuel Pump.

The ECM controls Fuel Pressure through the Suction Control Valve by limiting the inlet orifice of the Fuel Pump.

To Test Voltage:

See ECM Pin #D1 and D2.

Throttle Body

The Electronic Throttle Body incorporates:
Throttle Control Motor and Throttle Position Sensor.

Throttle Control Motor

The Throttle Control Motor is located at the Throttle Body. The ECM actuates this motor to control the opening of the throttle plate.

To Test Voltage:

See ECM Pin #C4.

Throttle Position Sensor

The potentiometer type Throttle Position Sensor is located at the Throttle Body. The ECM monitors this sensor to determine the actual throttle opening.

To Test Voltage:

See ECM Pin #C29 and ECM Pin #D18 and D28.

Transponder Key ECM

The Transponder Key ECM is located behind the centre of the dash.

To Test Voltage:

See ECM Pin #A16 and ECM Pin #B29 and B30.

Turbocharger Variable Nozzle Sensor

The Turbocharger Variable Nozzle Sensor is located at the turbocharger.

The ECM monitors this sensor to determine the position of the turbocharger variable nozzle.

Turbocharger Variable Nozzle Motor

The Turbocharger Variable Nozzle Motor is located at the turbocharger. The ECM actuates this motor through the Turbocharger Motor Driver to control turbocharger boost.

Turbocharger Motor Driver

The Turbocharger Motor Driver is located behind the glove box. The ECM controls the turbocharger motor through this driver

To Test Voltage:

See ECM Pin #D10 and D17.

Turbocharger Pressure Sensor

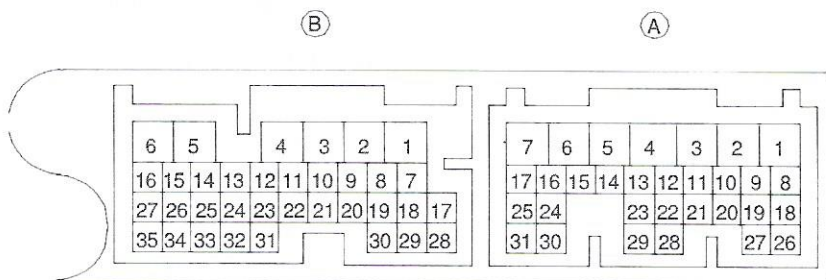
The Turbocharger Pressure Sensor is located at the aftercooler outlet pipe. The ECM monitors this sensor to determine turbocharger boost.

To Test Voltage:

See ECM Pin #C28 and ECM Pin #D18 and D28.

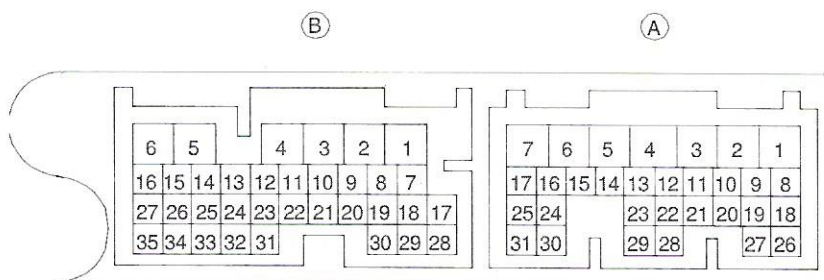
Vehicle Speed Sensor

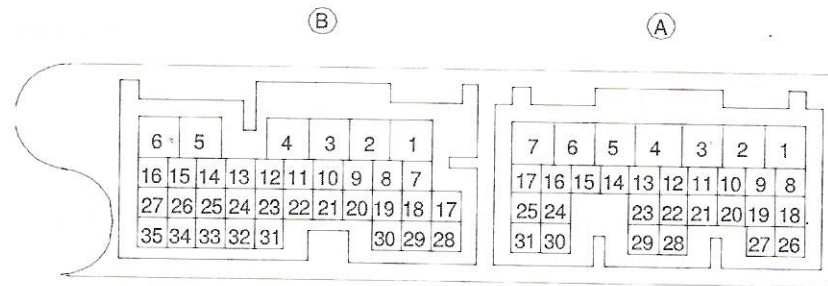
The Vehicle Speed Sensor is located at the transmission. It provides a signal to the instruments proportional to vehicle speed.

ECM Voltage Table**Connector 'A'**

Pin #	Circuit and Status	Voltage
A1	ECM Power Supply Ignition ON	Battery Volts
A2	Engine Coolant Temperature Gauge Signal No Specifications Available	N/A
A3	DM Signal to Instrument Panel No Specifications Available	N/A
A4	Tachometer Signal Engine Running	Voltage Pulse
A6	Neutral Switch (Auto) Engine Running Transmission Lever in Park or Neutral Transmission Lever in Any Other Gear	0 to 1.5 Volts Battery Volts
A7	Starter Signal Engine Cranking	>6 Volts
A8	Main Relay Control Ignition ON 10 Seconds after Ignition OFF	Battery Volts 0 to 1.5 Volts
A9	Ignition Feed Ignition ON	Battery Volts
A10	EDU Relay Control Ignition OFF Engine Idling	Battery Volts 0 to 1.5 Volts
A11	Diagnostic Connector terminal 11 (TC) Ignition ON	Battery Volts
A12	Malfunction Indicator Lamp Engine Running Lamp OFF Lamp ON	Battery Volts 0 to 1.5 Volts
A14	Glow Indicator Lamp Lamp OFF Lamp ON	Battery Volts 0 to 1.5 Volts
A15	Glow Relay Control Engine Cranking Engine Idling	Battery Volts 0 to 1.5 Volts

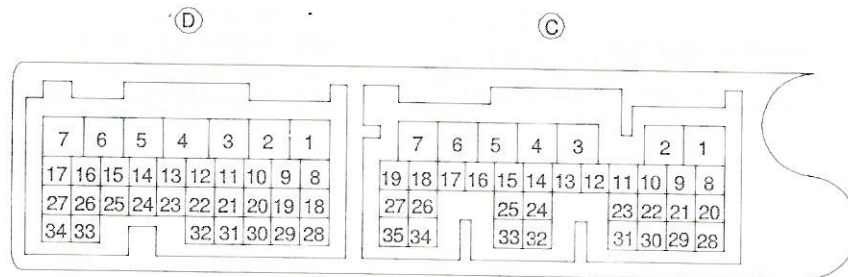
Pin #	Circuit and Status	Voltage
A16	Transponder Key ECM No Specifications Available	N/A
A18	Diagnostic Connector terminal 7 (SIL) Scan Tool Connected	Voltage Pulse
A19	Diagnostic Connector terminal 15 (WFSE) No Specifications Available	N/A
A20	ATCP Module (If Fitted) BUS Negative	Serial Data
A21	ATCP Module (If Fitted) BUS Positive	Serial Data
A22	Accelerator Pedal Position Sensor Signal (Engine Control) Ignition ON Pedal at Idle Position Pedal at Wide Open Position	0.6 to 1.0 Volts 3.0 to 4.6 Volts
A23	Accelerator Pedal Position Sensor Signal (Malfunction Detection) Ignition ON Pedal at Idle Position Pedal at Wide Open Position	1.4 to 1.8 Volts 3.7 to 5.0 Volts
A26	Accelerator Pedal Position Sensor Power Supply (Engine Control) Ignition ON	4.5 to 5.5 Volts
A27	Accelerator Pedal Position Sensor Power Supply (Malfunction Detection) Ignition ON	4.5 to 5.5 Volts
A28	Accelerator Pedal Position Sensor Ground (Engine Control) All Times	0 to 1.5 Volts
A29	Accelerator Pedal Position Sensor Ground (Malfunction Detection) All Times	0 to 1.5 Volts





Connector 'B'

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
B2	Permanent Power Supply All Times	Battery Volts	B19	Air Conditioner Amplifier No Specifications Available	N/A
B14	Brake Switch 2 Ignition ON Brake Pedal at Rest > Brake Pedal Depressed	7.5 Volts 0 to 1.5 Volts	B20	Air Conditioner Amplifier No Specifications Available	N/A
B15	Brake Lamp Switch Brake Pedal at Rest Brake Pedal Depressed	0 to 1.5 Volts >7.5 Volts	B21	Automatic Transmission Control Module CAN - Ignition ON	Serial Data
B17	Vehicle Speed Signal Ignition ON Drive Wheel Rotating Slowly	Voltage Pulse	B22	Automatic Transmission Control Module CAN + Ignition ON	Serial Data
B18	Air Conditioner Amplifier No Specifications Available	N/A	B29	Transponder Key ECM No Specifications Available	N/A
			B30	Transponder Key ECM No Specifications Available	N/A



Connector 'C'

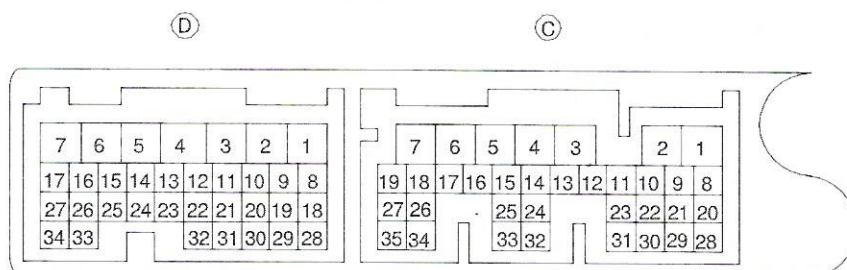
Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
C4	Throttle Motor Control Engine Running	Duty Cycle	C28	Manifold Absolute Pressure Sensor Signal Ignition ON 40 kPa Negative Pressure Applied Atmospheric Pressure Applied 170 kPa Positive Pressure Applied	1.3 to 1.9 Volts 2.4 to 3.1 Volts 3.7 to 4.3 Volts
C7	Ground All Times	0 Volts	C29	Throttle Position Sensor Signal Ignition ON Throttle Valve @ Idle Position Throttle Valve @ Wide Open Position	0.4 to 1.0 Volts 3.6 to 4.2 Volts
C9	Exhaust Gas Recirculation Solenoid Ignition ON	Voltage Pulse	C31	Camshaft Position Sensor Signal Negative Engine Cranking or Idling	Voltage Pulse
C18	Exhaust Gas Recirculation Cut Solenoid No Specifications Available	N/A	C32	Mass Air Flow Meter Ground All Times	0 to 1.5 Volts
C23	Camshaft Position Sensor Signal Positive Engine Cranking or Idling	Voltage Pulse			
C24	Mass Air Flow Meter Signal No Specifications Available	N/A			

Connector 'D'

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
D1	Suction Control Valve Negative Engine Idling	Duty Cycle	D19	Engine Coolant Temperature Sensor Signal Engine Idling Coolant Temperature @ 80°C	0.2 to 1.0 Volts
D2	Suction Control Valve Positive Engine Idling	Duty Cycle	D20	Inlet Air Temperature Sensor No Specifications Available	N/A
D6	Ground All Times	0 Volts	D21	Fuel Injector #4 Ignition ON Engine Idling	Battery Volts Voltage Pulse
D7	Ground All Times	0 Volts	D22	Fuel Injector #3 Ignition ON Engine Idling	Battery Volts Voltage Pulse
D8	Alternator Engine Idling	Duty Cycle	D23	Fuel Injector #2 Ignition ON Engine Idling	Battery Volts Voltage Pulse
D10	Turbo Motor Driver (VNT0 Signal) No Specifications Available	N/A	D24	Fuel Injector #1 Ignition ON Engine Idling	Battery Volts Voltage Pulse
D15	Intake Manifold Swirl Control Solenoid No Specifications Available	N/A			
D17	Turbo Motor Driver (VNT1 Signal) No Specifications Available	N/A			
D18	Sensor Power Supply Ignition ON	4.5 to 5.5 Volts			

Connector 'D' (Cont.)

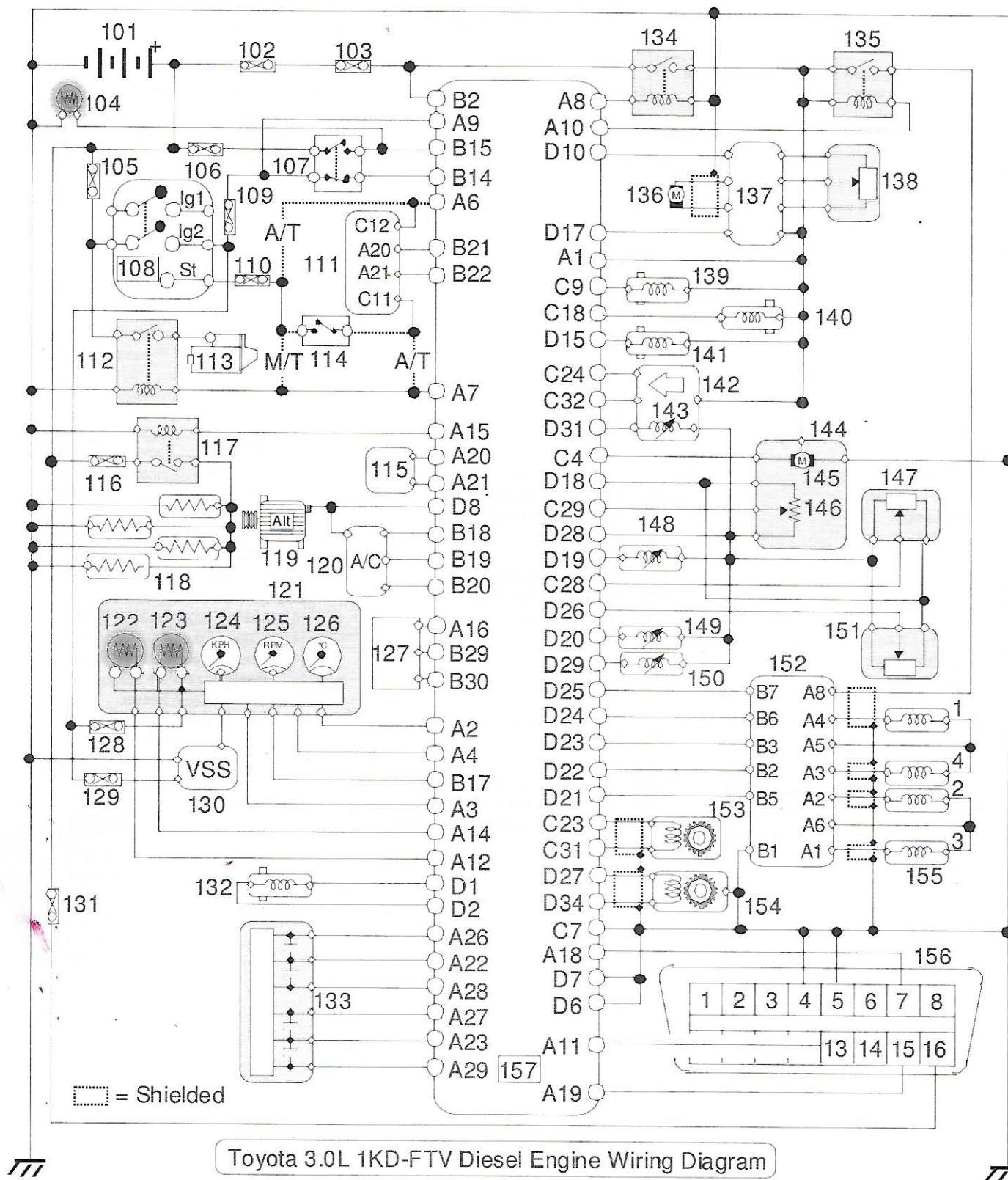
Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
D25	Fuel Injector Feedback (INJF) Signal		D29	Fuel Temperature Sensor	
	Engine Idling	Voltage Pulse		Ignition ON	0.5 to 3.4 Volts
D26	Fuel Pressure Sensor		D31	Intake Air Temperature Sensor Signal	
	Engine Idling	1.3 to 1.8 Volts		Engine Idling	
D27	Crankshaft Position Sensor Signal Positive			Intake Air Temperature @ 20°C	0.5 to 3.4 Volts
	Engine Cranking or Idling	Voltage Pulse	D34	Crankshaft Position Sensor Signal Negative	
D28	Sensor Ground			Engine Cranking or Idling	Voltage Pulse
	All Times	0 Volts			



Key to Wiring Diagram (next page)

101. Battery	120. Air Conditioner Amplifier	139. Exhaust Gas Recirculation Solenoid
102. Fuse Batt P/I - 50 Amp	121. Instrument Panel	140. Exh Gas Recirculation Cut Solenoid
103. Fuse EFI - 25 Amp	122. Malfunction Indicator Lamp	141. Intake Manifold Swirl Control Valve
104. Brake Lamps	123. Glow Indicator Lamp	142. Mass Air Flow Meter
105. Fuse AM2 - 30 Amp	124. Speedometer	143. Intake Air Temperature Sensor
106. Fuse Stop - 10 Amp	125. Tachometer	144. Throttle Body
107. Brake Lamp Switch	126. Coolant Temperature Gauge	145. Throttle Control Motor
108. Ignition Switch	127. Transponder Key ECM	146. Throttle Position Sensor
109. Fuse Ign - 7.5 Amp	128. Fuse Met 7.5 Amp	147. Turbocharger Pressure Sensor
110. Fuse St - 7.5 Amp	129. Fuse ECUlg & Gauge 10 Amp	148. Engine Coolant Temperature Sensor
111. Auto Transmission Control Module	130. Vehicle Speed Sensor	149. Inlet Air Temperature Sensor
112. Starter Relay	131. Fuse OBD 7.5 Amp	150. Fuel Temperature Sensor
113. Starter Motor	132. PCV Suction Control Valve	151. Fuel Pressure Sensor
114. Inhibitor Switch (Auto)	133. Accelerator Pedal Position Sensor	152. Injector Driver Unit (EDU)
115. ATCP Module (If Fitted)	134. Main Relay	153. Camshaft Position Sensor
116. Fuse Glow - 80 Amp	135. Injector Driver (EDU) Relay	154. Crankshaft Position Sensor
117. Glow Relay	136. Turbocharger Variable Nozzle Motor	155. Fuel Injectors
118. Glow Plugs	137. Turbocharger Motor Driver	156. Diagnostic Connector
119. Alternator	138. Turbocharger Variable Nozzle Sensor	157. Engine Control Module (ECM)

Wiring Diagram



Manufacturer: NISSAN

Application: R51 Pathfinder 2007, D40 Navara 2007
2.5 Turbo Diesel YD25DDTi
Includes Models with Diesel Particulate Filter

Subject: Engine Management System

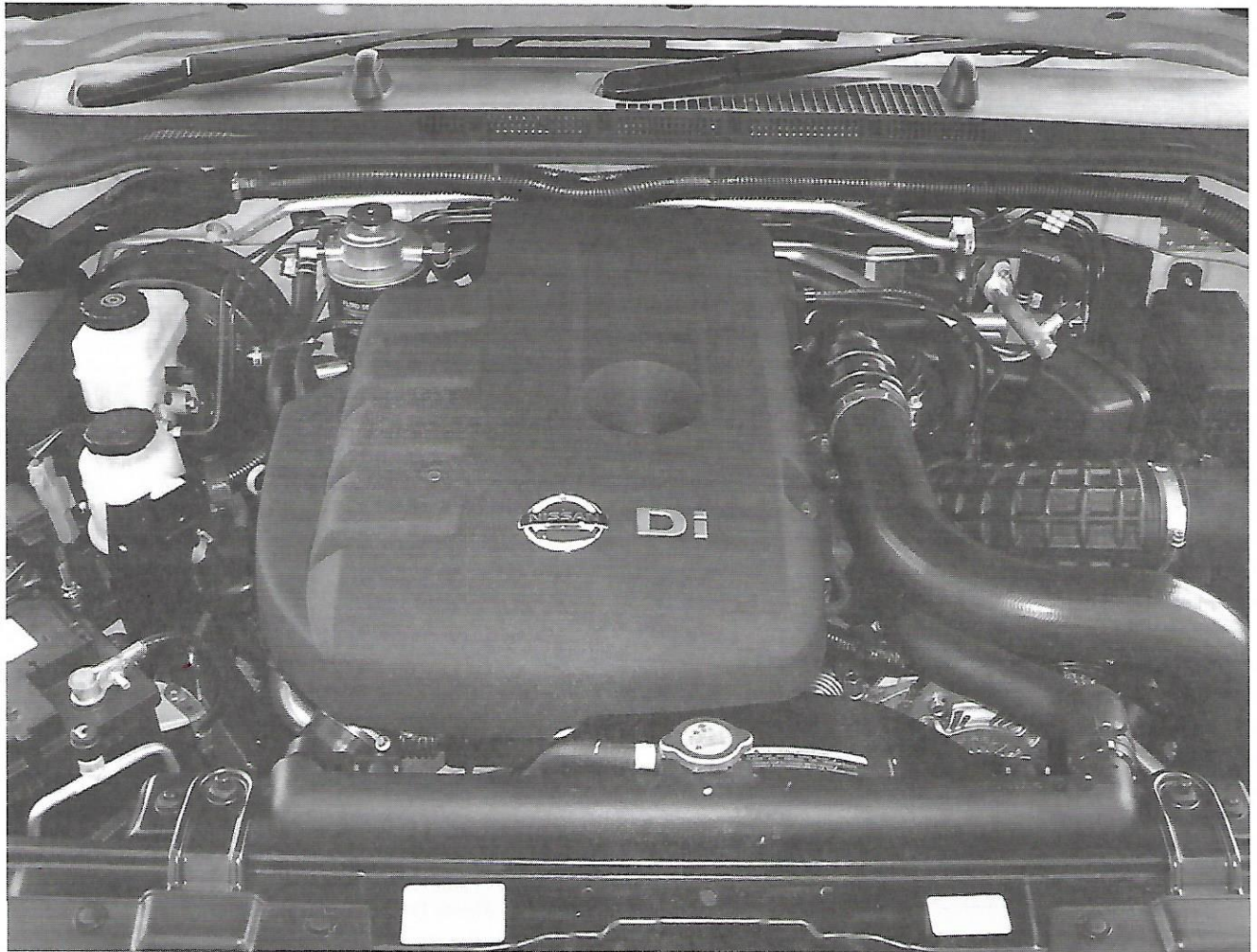
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Overview

These vehicles are fitted with a 2.5 Litre DOHC 16 valve direct injection I4 Diesel engine. The Denso Common Rail fuel injection system is fitted. The Fuel Injectors are operated sequentially. Fuel is injected up to 3 times per cycle. Air mass calculation is by a Mass Air Flow Sensor. The cruise control system is managed by the ECM. The "NATS" Immobilisation System is fitted to most models. A Diesel Particulate Filter (DPF) is fitted to Automatic Transmission models.

The following are all electronically controlled:

- Glow Plug Control
- Exhaust Gas Recirculation
- Fuel Injector Operation
- Fuel Pressure
- Accelerator Operation
- Turbocharger Boost
- DPF Regeneration



ECM

The 121 pin ECM is located in the right rear corner of the engine compartment. Two connectors are used.

Note!

Swing each connector release lever inwards to release.

Warning

High voltages are used to operate the fuel injectors. Ensure ignition is OFF before touching or disconnecting injector wiring.

Note!

If the ECM is replaced, it will be necessary to conduct a Service Regeneration of the Diesel Particulate Filter (Auto Trans).

ECM Grounds

Key grounds for the ECM are all interconnected:

- E21 - Right side of engine compartment adjacent to the ECM
- E41:- Manual – Below the battery (remove battery and plastic tray to improve access)
Auto Trans – Below air cleaner on horizontal sheet metal adjacent to alternator
- E61 - Left side of engine compartment behind air filter housing.

ECM Pin A35 - Air Fuel Ratio Sensor Heater Ground (Auto Trans) is located adjacent to the battery, below the Fusible Link Box.

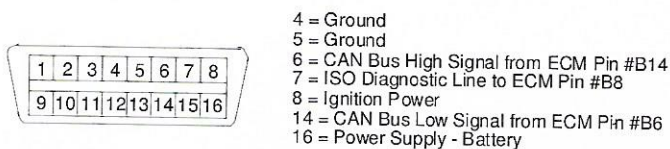
ECM Backprobing

To access the ECM connector for backprobing, the connector covers must be removed.

1. Remove connector from ECM
2. Remove cable tie (If Fitted)
3. Unclip cover at front
4. Disengage and pull out from the rear
5. Disengage release lever from slides
6. Lift off cover and release lever
7. Pull out slides
8. Push connector back into the ECM for backprobing and testing
9. Refit covers by reversing the above procedure.

Diagnostic Connector

The 16 pin OBDII type Diagnostic Connector is located underneath the driver side dash. A scan tool can be connected to this connector for diagnosis. These vehicles use the Controller Area Network (CAN) System for communication. An ISO 9141 circuit is used for diagnosis.



Nissan Diagnostic Connector

Fault Codes

Fault Codes are OBDII type. They can be accessed by an OBDII compatible scan tool or manually.

Manual Codes

4 digit manual codes are displayed as flashes of the Malfunction Indicator Lamp.

The manual code display is as follows:

- First digit - 0.6 second flashes (10 flashes = 0)
- There will be a 1.6 second pause
- Second digit - 0.3 second flashes
- There will be a 1.3 second pause
- Third digit - 0.3 second flashes
- There will be a 1.3 second pause
- Fourth digit - 0.3 second flashes.

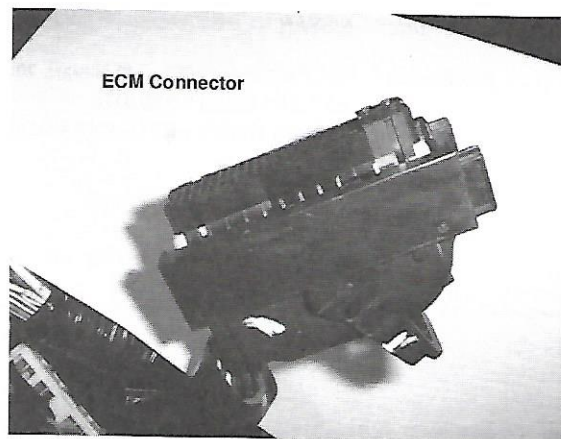
There is a 1.8 second pause between codes.
No faults will display Manual Code "0000".

Fault Code Erasure

Fault Code Erasure can be carried out with an OBDII compatible scan tool or manually.

Fault Code Extraction

Fault Codes can be extracted with an OBDII compatible scan tool or manually.



Note!

Switch OFF ignition and wait 10 seconds before running any Fault Code Extraction.

Manual Extraction (Diagnostic Mode)

1. Ignition must be OFF for 10 seconds
2. Switch Ignition ON and wait 3 seconds
3. Repeat the following FIVE TIMES within 5 seconds:
 - a. Fully depress accelerator
 - b. Release accelerator
4. Wait 7 seconds, fully depress accelerator for approx 10 seconds until MIL Lamp starts flashing
5. Release accelerator
6. ECM is in Diagnostic Mode, Manual Codes will be displayed as flashes of the Malfunction Indicator Lamp.

Note!

If the accelerator is full depressed for 10 seconds after the code display has begun, memory codes will be cleared.

Manual Erasure

1. Carry out Manual Fault Code Extraction
2. Once the code display has begun, depress accelerator fully for 10 seconds
3. Memory codes will be cleared.

Note!

It can take up to 24 hours to erase codes by removing the battery terminal.
Ensure that all memory codes are recorded prior to performing this procedure.

Freeze Frame Data

Freeze Frame Data provides a snap shot of conditions present and how the vehicle was driven if an emission related Fault Code logs. It can help isolate the cause of the Fault Code. An OBD II compatible scan tool is required to access this data.

Fault Code Identification

Code #	Circuit	Code #	Circuit
U1000	CAN Communication Circuit Fault	P0341	Camshaft Position Sensor Range or Performance Fault
P0000	No Faults Detected	P0427	Front Exh. Temp. Sensor Signal Voltage Low - DPF
P0016	Crankshaft Position Sensor and Camshaft Position Sensor Correlation Error	P0428	Front Exh. Temp. Sensor Signal Voltage High - DPF
P0088	Fuel Rail Pressure Too High	P0437	Rear Exh. Temp. Sensor Signal Voltage Low - DPF
P0089	Fuel Rail Pressure is Higher than Target Pressure	P0438	Rear Exh. Temp. Sensor Signal Voltage High - DPF
P0093	Fuel System Leak Detected	P0471	Diff. Exh. Pressure Sensor Signal Range or Performance - DPF
P0102	Mass Air Flow Sensor Circuit Low Input	P0472	Diff. Exh. Pressure Sensor Signal Voltage Low - DPF
P0103	Mass Air Flow Sensor Circuit High Input	P0473	Diff. Exh. Pressure Sensor Signal Voltage High - DPF
P0112	Intake Air Temperature Sensor Low Input	P0478	Diff. Exh. Pressure Sensor Upstream Pressure Circuit Fault - DPF
P0113	Intake Air Temperature Sensor High Input	P0501	Vehicle Speed Sensor Range or Performance Fault
P0117	Engine Coolant Temperature Sensor Circuit Low Input	P0502	Vehicle Speed Sensor Circuit Low Input
P0118	Engine Coolant Temperature Sensor Circuit High Input	P0503	Vehicle Speed Sensor Circuit High Input
P0122	Accelerator Pedal Position Sensor #1 Circuit Low Input	P0504	Cruise Control Brake Switch or Circuit Fault
P0123	Accelerator Pedal Position Sensor #1 Circuit High Input	P0563	Battery Voltage Too High
P0130	Air/Fuel Ratio Sensor or Circuit Fault - DPF	P0580	Cruise Control Steering Wheel Switch Circuit Input Low
P0131	Air/Fuel Ratio Sensor Signal Voltage Low - DPF	P0581	Cruise Control Steering Wheel Switch Circuit Input High
P0132	Air/Fuel Ratio Sensor Signal Voltage High - DPF	P0605	ECM Internal Ram Fault
P0134	Air/Fuel Ratio Sensor Signal No Activity Detected - DPF	P0606	ECM Fault
P0135	Air/Fuel Ratio Sensor Heater or Circuit Fault - DPF	P0628	Fuel Pump Control Circuit Low Input
P0182	Fuel Injector Pump Temperature Sensor Input Low	P0629	Fuel Pump Control Circuit High Input
P0183	Fuel Injector Pump Temperature Sensor Input High	P0638	Electronic Throttle Control Actuator Performance Fault - DPF
P0192	Fuel Rail Pressure Sensor Circuit Low Input	P0642	Accelerator Pedal Position Sensor #1 Power Supply Circuit Low
P0193	Fuel Rail Pressure Sensor Circuit High Input	P0643	Accelerator Pedal Position Sensor #1 Power Supply Circuit High
P0200	Fuel Injector Power Supply Circuit Low Voltage	P0652	Accelerator Pedal Position Sensor #2 Power Supply Circuit Low
P0201	Fuel Injector #1 Circuit Open	P0653	Accelerator Pedal Position Sensor #2 Power Supply Circuit High
P0202	Fuel Injector #2 Circuit Open	P0686	Main Relay Circuit Fault
P0203	Fuel Injector #3 Circuit Open	P1211	Traction Control System Circuit Fault
P0204	Fuel Injector #4 Circuit Open	P1212	CAN Bus Fault between Engine ECM and ABS ECM
P0217	Engine Over Temperature Condition	P1268	Fuel Injector #1 Stuck Open
P0222	Accelerator Pedal Position Sensor #2 Circuit Low Input	P1269	Fuel Injector #2 Stuck Open
P0223	Accelerator Pedal Position Sensor #2 Circuit High Input	P1270	Fuel Injector #3 Stuck Open
P0234	Turbocharger Over Boost Condition	P1271	Fuel Injector #4 Stuck Open
P0237	Turbocharger Boost Sensor Circuit Low Input	P1272	Fuel Rail Pressure Relief Valve Open
P0238	Turbocharger Boost Sensor Circuit High Input	P1273	Fuel Pump Insufficient Flow
P0335	Crankshaft Position Sensor Circuit Fault	P1274	Fuel Pressure Higher than Target Value
P0336	Crankshaft Position Sensor Range or Performance Fault	P1275	Fuel Pressure Higher than Target Value
P0340	Camshaft Position Sensor Circuit Fault		

Code #	Circuit
P1472	Engine Room Air Temp. Sensor Voltage Low – DPF
P1473	Engine Room Air Temp. Sensor Voltage High – DPF
P1610	Immobilisation (NATS) System Fault – Lock Mode
P1611	Immobilisation (NATS) System Communication Fault ECM to BCM
P1612	Immobilisation (NATS) System Communication Fault ECM to BCM
P1613	Immobilisation (NATS) System Fault
P1614	Immobilisation (NATS) System Fault BCM Cannot Receive Key Signal
P1615	Immobilisation (NATS) System Fault BCM Cannot Verify Key Signal
P1616	ECM ROM Fault
P1622	Fuel Injector Adjustment Value Not Registered in ECM
P1623	Fuel Injector Adjustment Value Data Error
P2002	Particulate Matter Over Accumulation – DPF

Accelerator Pedal Position Sensor

The Accelerator Pedal Position Sensor is located at the accelerator pedal. The ECM monitors this sensor for driver demand. It uses this signal along with its other inputs to determine the amount of engine fuel required.

To Test Voltage:

See ECM Pin #B1, B2, B3, B9, B10 and B11.

Accelerator System

These vehicles use a fly by wire Accelerator System without a cable. With this system, the ECM controls the fuel delivery based on driver demand from the Accelerator Pedal Position Sensor. The system also controls idle speed, cruise control and Vehicle Dynamic Control (If Fitted).

The system incorporates:

- Accelerator Pedal Position Sensor
- ECM
- Fuel Injectors.

Note!

The Throttle Actuator Motor and Throttle Valve are NOT used for acceleration control.

Their function is to:

- Control Diesel Particulate Filter Regeneration (If Fitted)
- Reduce engine shake on shut-down.

Air Conditioner Cutout Relay

The A/C Cutout Relay is located in the Power Distribution Module. The Power Distribution Module controls switching of the relay. The ECM requests its operation via the CAN Communication Bus.

Air Conditioner Pressure Sensor

The A/C Pressure Sensor is located at the right side of the A/C condenser. The ECM monitors the discharge pressure of the A/C system. It is used to interrupt system operation in the case of excessively high or low pressures.

To Test Voltage:

See ECM Pin #A53, A64 and A72.

Code #	Circuit
P2118	Electronic Throttle Control Motor Performance Fault – DPF
P2119	Electronic Throttle Control Actuator Performance Fault - DPF
P2135	Accelerator Pedal Position Sensor Incorrect Voltages Between #1 and #2
P2146	Fuel Injector #1 and #4 Power Supply Circuit Open
P2147	Fuel Injector Circuit Low Input
P2148	Fuel Injector Circuit High Input
P2149	Fuel Injector #2 and #3 Power Supply Circuit Open
P2228	Barometric Air Pressure Sensor Circuit Low Input
P2229	Barometric Air Pressure Sensor Circuit High Input
P2297	Air/Fuel Ratio Sensor Out of Range during Deceleration – DPF
P2621	Throttle Position Sensor Signal Voltage Low – DPF
P2622	Throttle Position Sensor Signal Voltage High – DPF

Air Fuel Ratio Sensor (Auto Trans)

The Air Fuel Ratio Sensor is located at the rear of the Diesel Particulate Filter. It is used by the ECM during Diesel Particulate Filter Regeneration.

To Test Voltage:

See ECM Pin #A34, B4 and B12.

To Test Heater Resistance at @ 25° C:

Disconnect connector and measure between terminals:
Should be 1.8 to 2.44 Ohms.

Air Fuel Ratio Sensor – Learnt Value Clearing (Auto Trans)

If the:

- Air Fuel Ratio Sensor has been replaced
 - ECM has been replaced with a second hand one,
- The Air Fuel Ratio Sensor Learnt Value Clearing procedure should be conducted.

A compatible scan tool is required to conduct this procedure.

Anti-lock Braking System (ABS) ECM (If Fitted)

The ABS ECM is located at the ABS Modulator in the left rear corner of the engine compartment.

It is integrated with the Vehicle Dynamic Control Module (If Fitted). The ECM monitors this module for vehicle speed.

Anti Theft Lamp (If Fitted)

The Anti Theft Lamp red LED is located in the Instrument Cluster. It is part of the Immobilisation System (If Fitted). As a visual deterrent, the Lamp flashes every 3 seconds. It is switched by the Body Control Module.

Lamp Operation

When the ignition is switched ON, the lamp will be OFF.

10 seconds after switching the ignition OFF or to Accessory or Lock positions, the Lamp flashes every 3 seconds.

If there is a fault with the Immobilisation System, the Anti Theft Lamp will remain ON.

See Immobilised State.

Barometric Air Pressure Sensor

The Barometric Air Pressure Sensor is incorporated within the ECM.

Brake Lamp Switch

The Brake Lamp Switch is located at the pedal cluster.
The ECM monitors this switch for brake pedal application.

To Test Voltage:
See ECM Pin #B19.

Body Control Module (BCM)

The Body Control Module is located under the dash panel on the driver's side. The BCM contains the Immobilisation System functions (If Fitted).

It is connected to the CAN Communication Bus.
See Immobilisation System.

Camshaft Position Sensor

The Camshaft Position Sensor is located at the left rear of the cylinder head. It is a Hall Effect sensor.
The exhaust camshaft has 5 trigger notches at the end.
The ECM monitors this sensor for camshaft position.

To Test Voltage:
See ECM Pin #A45, A47 and A66.

Crankshaft Position Sensor

The Crankshaft Position Sensor is located at the right side of the flywheel housing. It is accessed from below the vehicle.
It is a Hall Effect sensor.
The ECM uses this signal to determine engine speed and crankshaft position.

To Test Voltage:
Manual – See ECM Pin #A44 and A46 and A65
Auto – See ECM Pin #A46 and A65 and ECM Pin #B1.

Note!

The Crankshaft Position Sensor must be removed from the flywheel housing to avoid damage when the transmission is being removed.

Cruise Control (If Fitted)

Cruise Control is carried out internally by the ECM.
The ECM controls cruise through the quantity of fuel injected.

Cruise Control Brake Switch (If Fitted)

The Cruise Control Brake Switch is located at the pedal cluster.
It is a normally closed switch.
The ECM monitors this switch for brake pedal application to cut out the cruise mode.

To Test Voltage:
See ECM Pin #B20.

Cruise Control Clutch Pedal Switch (Manual)

The Clutch Pedal Switch is located at the pedal cluster.
It is a normally closed switch. The ECM monitors this switch for clutch pedal application to cut out the cruise mode.

To Test Voltage:
See ECM Pin #B20.

Cruise Control Switches (If Fitted)

The Cruise Control Switches are located on the right side of the steering wheel. They are momentary contact switches connected through the clockspring to the ECM.
The ECM monitors these switches for cruise demand.
Each switch produces a different voltage level signal to request a cruise function from the ECM.

To Test Voltage:
See ECM Pin #B21 and B22.

To Test Resistance @ 20°C:
Disconnect clockspring connector and measure between terminals.

Switch Pressed	Approx. Resistance Ohms
None	4000
RES/ACCEL	1480
SET/COAST	660
CANCEL	250
MAIN	0

Diesel Particulate Filter (Auto Trans)

The Diesel Particulate Filter (DPF) is located in the exhaust pipe adjacent to the transmission.
Externally it looks similar to a catalytic converter. Its function is to collect particulate matter from the exhaust gases. It regularly regenerates by burning off the accumulated particulate matter.

Regeneration is controlled by the ECM, using the following sensors and actuators:

- Air Fuel Ratio Sensor
- Engine Compartment Temperature Sensor
- Exhaust Differential Pressure Sensor
- Exhaust Gas Temperature Sensor – Upstream
- Exhaust Gas Temperature Sensor – Downstream
- Throttle Actuator Motor
- Throttle Position Sensor
- Variations to injection quantity and timing.

At times during the life of a vehicle a DPF Service Regeneration may be required.

Diesel Particulate Filter – Active Regeneration (Auto Trans)

Active Regeneration is an automatic process that is transparent to the driver. It occurs during NORMAL driving conditions. It is initiated by the ECM between every 200 to 800 kilometres, depending on driving conditions.

Note!

If driving cycles consist of very short runs, the conditions may not allow Active Regeneration to occur.
See Engine Performance (Auto Trans).
The exhaust system reaches extremely high temperatures during Regeneration.

Diesel Particulate Filter – Data Clear (Auto Trans)

If the Diesel Particulate Filter (DPF) assembly is replaced with a new unit, the DPF Data stored in the existing ECM must be cleared. This ensures the new DPF will be regenerated at the appropriate time. A compatible scan tool is required to conduct this procedure.

Diesel Particulate Filter – Failsafe Mode (Auto Trans)

If the ECM detects that the Diesel Particulate Filter (DPF) has blocked to an unsafe level, it will initiate Failsafe Mode.

In Failsafe Mode:

- The DPF Warning Lamp will be illuminated
- Fault Code P2002 will be logged
- Engine speed will be limited to 2000 RPM

When this occurs, conduct a Diesel Particulate Filter (DPF) Service Regeneration.

See also Engine Performance (Auto Trans).

Note!

The engine Malfunction Indicator Lamp will NOT illuminate with a P2002 logged.

Diesel Particulate Filter – Service Regeneration (Auto Trans)

A Diesel Particulate Filter (DPF) Service Regeneration will be required if the:

- ECM has been replaced.
- ECM has entered Failsafe Mode.

This can occur if accumulated particulate matter has reached a specified level and the normal driving cycle has been insufficient to conduct an automatic Active Regeneration. A compatible scan tool is required to conduct this procedure. Service Regeneration can take approximately 75 minutes.

See also Engine Performance (Auto Trans).

Note!

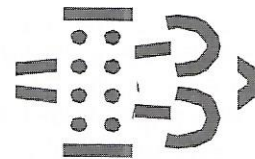
The exhaust system reaches extremely high temperatures during Regeneration.

The Service Regeneration procedure causes significant fuel dilution of the engine oil. The engine oil and filter must be replaced at the end of the procedure.

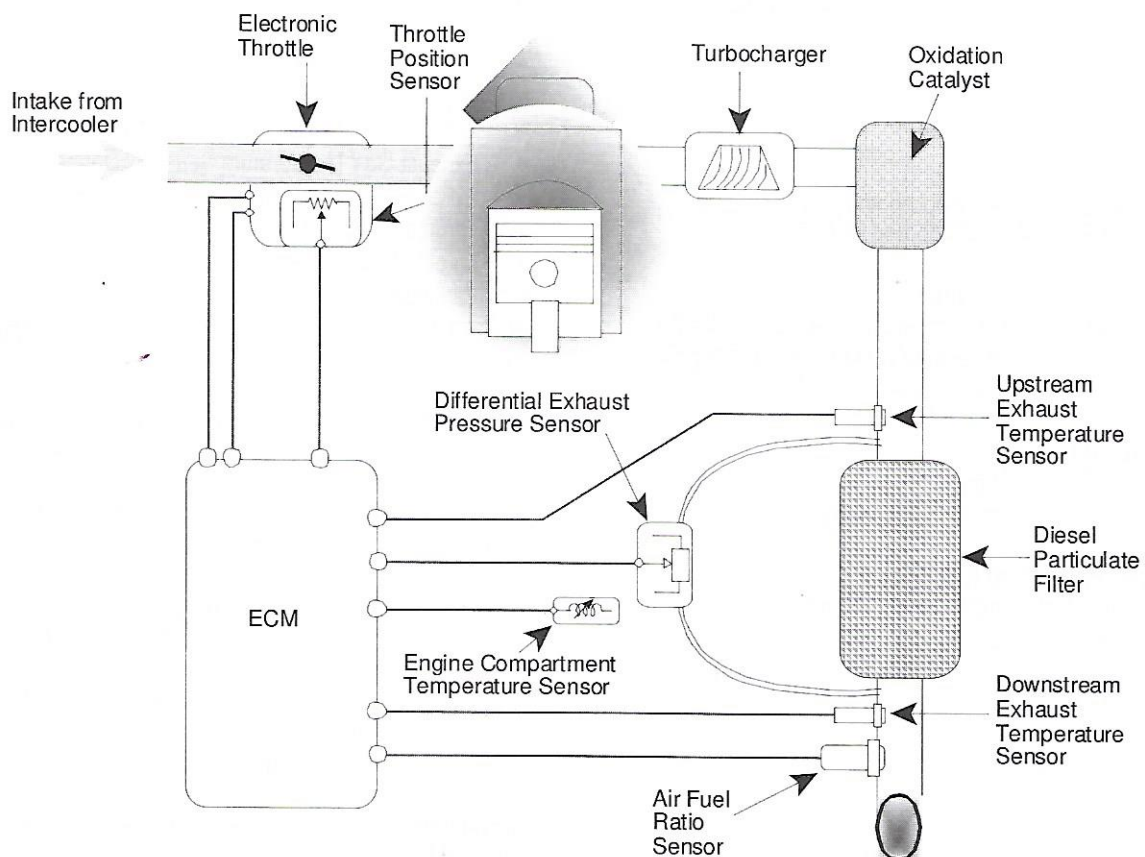
Diesel Particulate Filter Warning Lamp (Auto Trans)

The Diesel Particulate Filter (DPF) Warning Lamp is located at the instrument cluster. It is an amber coloured lamp. It is illuminated when the ignition is switched ON as a self test. It should extinguish when the engine is started. Its function is to warn the driver of a fault in the DPF or in the DPF regeneration control system. The lamp is controlled by the ECM via the CAN Communication Bus.

See also Engine Performance (Auto Trans).



Diesel Particulate Filter Warning Lamp



Nissan YD25 Diesel Particulate Filter System Schematic

Electronic Controlled Engine Mounting Solenoid (If Fitted)

The Electronic Controlled Engine Mounting Solenoid is located at the top of the engine block below the intake manifold.

The ECM reduces the stiffness of the engine mounting at idle to reduce vibration transmission to the vehicle. At idle, vacuum is applied to the front engine mountings to soften damping. Above 900 RPM, vacuum is removed to increase damping.

To Test Voltage:

Manual – See ECM Pin #A34.

Auto – See ECM Pin # A17.

Engine Compartment Temperature Sensor (Auto Trans)

The Engine Compartment Temperature Sensor is located in the left rear corner of the engine compartment. This is a thermistor type sensor. The ECM uses this signal to provide a correction factor for the Exhaust Differential Pressure Sensor signal.

To Test Voltage:

See ECM Pin #A75 and A79.

Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor is located at the front of the cylinder head on the right side.

The resistance of this thermistor decreases as temperature rises. The ECM monitors this sensor to determine the engine coolant temperature. It is also used by the ECM to control electric Cooling Fan Operation.

To Test Voltage:

See ECM Pin #A51 and A70.

To Test Resistance:

Disconnect connector and measure across the sensor terminals:

Temperature	Resistance
@ 20°C	2.1 to 2.9 k Ohms.
@ 50°C	0.68 to 1.0 k Ohms.
@ 90°C	0.236 to 0.260 k Ohms.

Engine Cooling Fans

These vehicles are fitted with a viscous coupling mechanical fan and an electric fan. The electric fan is located within the fan shroud.

The ECM controls 2 Relays to operate the electric fan at low and high speeds. ECM requests fan operation via the CAN

Communication Bus to the Power Distribution Module (PDM).

The PDM switches the Engine Cooling Fan Relays.

See also Engine Cooling Fan Operation.

Engine Cooling Fan Operation**Low Speed**

Relay #1 is energised by the Power Distribution Module (PDM). Current flows through the Engine Cooling Fan Resistor to the fan motor.

High Speed

Relay #2 is energised by the PDM.

Current by passes the Engine Cooling Fan Resistor and flows direct to the fan motor.

To Test:

Use scan tool to conduct active test.

See Also Power Distribution Module Auto Active Test.

Fan operation with A/C Off:

Coolant Temperature	Fan Speed
< 98°C	OFF
98°C to 104°C	Low
> 104°C	High

A CAN communication fault will cause the PDM to default the cooling fan to High Speed when the ignition is ON.

Engine Cooling Fan Relays

The 2 Engine Cooling Fan Relays are located in the Power Distribution Module (PDM). The ECM commands the PDM to actuate these relays via the CAN Communication Bus to control operation of the Engine Cooling Fan.

Engine Cooling Fan Resistor

The Engine Cooling Fan Resistor is located within the fan shroud. It provides low speed fan operation.

Engine Oil (Auto Trans)

Nissan specify ACEA C3 Low Ash 5W-30 engine oil for engines fitted with a Diesel Particulate Filter (DPF).

Correct oil grade and type is critical to DPF operation.

Ensure oil change intervals are kept up to date and the correct oil is used.

Note!

It is the servicing Technicians responsibility to ensure compatible oil is used.

Correct oil will minimise problems with the DPF.

Engine Performance (Auto Trans)

Normal Engine Performance can be affected by the condition of the Diesel Particulate Filter (DPF).

This will be apparent in one of the following ways:

- Sluggish engine with lack of power (DPF Warning Lamp NOT illuminated).
- Sluggish engine with lack of power (DPF Warning Lamp illuminated).
- Engine in Failsafe Mode , Max RPM 1200.(DPF Warning Lamp illuminated).

For each of these situations conduct the following procedures:

1. Sluggish engine
Drive vehicle for a period of 20 to 30 minutes at an uninterrupted speed of 80 to 100 km/h.
 - If engine performance has improved no further action is required.
 - If engine performance has not improved, conduct engine diagnosis for lack of performance.

Note!

Drive vehicle in a steady non aggressive manner.

2. Sluggish engine with DPF Warning Lamp illuminated
Drive vehicle for a period of 20 to 30 minutes at an uninterrupted speed of 80 to 100 km/h.
 - If engine performance is restored and DPF Warning Lamp extinguishes, no further action is required.
 - If engine performance has not improved and the DPF Warning Lamp remains illuminated, conduct DPF Service Regeneration.

3. Engine in failsafe mode with DPF Warning Lamp illuminated
Conduct DPF Service Regeneration.
- Change engine oil and filter at conclusion of Service Regeneration.
- Drive vehicle for a period of 20 to 30 minutes at an uninterrupted speed of 80 to 100 km/h to ensure performance has been restored.

Exhaust Differential Pressure Sensor (Auto Trans)

The Exhaust Differential Pressure Sensor is located in the left rear corner of the engine compartment.

It is a variable capacitance type pressure sensor.

It sends a voltage signal to the ECM indicating the exhaust pressure drop across the Diesel Particulate filter (DPF).

It is connected to the inlet and outlet sides of the DPF by separate rubber pressure sensing hoses.

The sensor measures the difference in exhaust pressure before and after the DPF. It is used by the ECM to determine the blockage status of the DPF and to schedule Active Regeneration.

To Test Voltage:

See ECM Pin # A58, A64 and A76.

Exhaust Gas Recirculation

The ECM controls the volume of exhaust gas recirculated to suit all conditions through the Exhaust Gas Recirculation Control Valve.

This reduces combustion temperatures and lowers exhaust emissions. A different system is used between Manual and Auto Transmissions.

Exhaust Gas Recirculation Valve (Manual Trans)

The Exhaust Gas Recirculation Valve is located at the front of the engine on the right. A stepper motor is used to vary the valve position and rate of exhaust gas flow.

To Test Voltage:

See ECM Pin #A25, A26, A27 and A28.

Exhaust Gas Recirculation Valve (Auto Trans)

The Exhaust Gas Recirculation Valve is located at the front of the engine on the right. A DC motor is used to vary the valve position and rate of exhaust gas flow.

It incorporates the Exhaust Gas Recirculation Position Sensor.

To Test Voltage:

See ECM Pin #A7, A8, A77 and A81 and ECM Pin #B1.

Exhaust Gas Recirculation Position Sensor (Auto Trans)

The Exhaust Gas Recirculation Position Sensor is located at the Exhaust Gas Recirculation Valve.

It is a potentiometer type sensor. It provides the ECM with feedback on the actual Control Valve position.

To Test Voltage:

See ECM Pin #A77 and A81 and ECM Pin #B1.

Exhaust Gas Recirculation Valve - Closed Position Learnt Value Clearing (Auto Trans)

If the:

- EGR Valve has been removed and refitted
- EGR Valve has been replaced,

The Closed Position Learnt Value Clearing procedure must be conducted. A compatible scan tool is required to conduct this procedure.

Note!

This procedure should be conducted with the coolant temperature between 0°C and 30°C.

Exhaust Gas Recirculation Valve - Closed Position Learning (Auto Trans)

The EGR Closed Position Learning procedure must be conducted if the:

- EGR Valve has been removed and refitted.
- EGR Valve has been replaced.
- ECM has been replaced.

Learning Procedure:

1. Switch the ignition ON for 10 seconds.
2. Switch the ignition OFF for 10 seconds.
3. Ensure that the EGR valve moves during the above 10 second OFF period.

Exhaust Gas Temperature Sensor – Upstream (Auto Trans)

The Upstream Exhaust Gas Temperature Sensor is located in the exhaust pipe before the Diesel Particulate Filter (DPF).

It is a thermistor type sensor.

It sends the ECM a voltage signal indicating the temperature of the exhaust gases. The ECM uses this signal during DPF Regeneration.

To Test Voltage:

See ECM Pin #A56 and A75

To Test Resistance:

Disconnect connector and measure across the sensor terminals:

Temperature	Resistance
@ 20°C	242 k Ohms.
@ 100°C	33.6 k Ohms.
@ 350°C	1.71 k Ohms.
@ 500°C	0.673 k Ohms.

Exhaust Gas Temperature Sensor – Downstream (Auto Trans)

The Downstream Exhaust Gas Temperature Sensor is located in the rear of the Diesel Particulate Filter (DPF) housing.

It is a thermistor type sensor.

It sends the ECM a voltage signal indicating the temperature of the exhaust gases. The ECM uses this signal during DPF Regeneration.

To Test Voltage:

See ECM Pin #A57 and A76.

To Test Resistance:

Disconnect connector and measure across the sensor terminals:

Temperature	Resistance
@ 20°C	242 k Ohms.
@ 100°C	33.6 k Ohms.
@ 350°C	1.71 k Ohms.
@ 500°C	0.673 k Ohms.

Fuel Filter and Priming Pump

The Fuel Filter and Priming Pump are located on the right side of the firewall. To prime; press the Bleed Pump button or bulb until it becomes firm.

The water sedimentor must be drained every 10,000 kilometres.

Fuel Injectors

The Fuel Injectors are located in the cylinder head and protrude through the rocker cover. They are operated sequentially through an injector driver unit integrated in the ECM. Should an injector be replaced, its Fuel Injector Calibration Code must be input into the ECM.

Warning!!

*The Injectors operate at around 80 volts.
Switch ignition OFF before removing connectors.*

To Test Voltage:

See ECM pin #A4, A5, A21, A22, A23, A24, A40, A41, A42 and A43.

To Test Resistance @ 20°C:

Disconnect connector and measure between terminals:
Should be approx. 0.2 to 0.8 Ohms.

Fuel Injector Calibration Code

The Fuel Injector Calibration Code is a unique, 30 digit, alphanumeric value printed on the head of each injector. They can be read by removing the connector.

Should an injector be replaced, the new injector's calibration code must be input into the ECM. Should the ECM be replaced, all of the existing calibration codes must be input into the new ECM.

A compatible scan tool is required to conduct this procedure. If an incorrect code is input into the ECM;

- The engine may rattle
- Engine idle may become rough
- Engine life may be shortened

Fuel Injector Pipes

The high pressure Fuel Injector Pipes are single use only.

To ensure correct sealing, they must be replaced with new pipes if removed.

Warning!!

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.

Fuel Pressure

Fuel Pressure is regulated at the Fuel Pump. The ECM controls the position of the Suction Control Valve to obtain the desired fuel pressure. This adjusts the inlet orifice thereby controlling the availability of fuel and the resultant pressure. Fuel pressure is read only from a scan tool. Maximum Fuel Pressure is limited by the Fuel Pressure Relief Valve on the common rail.

Note!

*Engine idling fuel pressure will be around 27,000 kPa (4,000 psi).
It WILL reach pressures of up to 180,000 kPa (26,000 psi).
Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes.*

Fuel Pressure Relief Valve

The Fuel Pressure Relief Valve is located at the end of the common fuel rail. It will open at approx 221,000 kPa and then close at approx. 50,000 kPa. This will only occur in over fuel pressure situations.

Note!

*Do not remove valve from the common rail.
If removed, the rail must be replaced as an assembly.*

Fuel Pressure Sensor

The Fuel Pressure Sensor is located at the front of the common fuel rail. The ECM monitors this sensor to determine the fuel pressure.

To Test Voltage:

See ECM Pin #A48, A49, A63 and A68.

Note!

*Do not remove sensor from the common rail.
If removed, the rail must be replaced as an assembly.*

Fuel Pump

The mechanical Fuel Pump is located at the right front of the engine.

It contains:

- Lift Pump
- Twin High Pressure pump elements
- Fuel Temperature Sensor
- Suction Control Valve

Pressurised fuel is supplied to the common rail and from there to each Fuel Injector. Fuel Pressure is ECM controlled by the Suction Control Valve limiting the inlet orifice of the pump.

Note!

*The Fuel Pump is driven by the timing chain
but is not timed to the engine.
The Fuel Pump is serviced only as an assembly.*

Fuel Pump Learned Values

The ECM learns what duty cycle it should apply to the Suction Control Valve to target a specific common rail pressure. Old duty cycle values should be cleared whenever system repairs are conducted and ideally when the fuel filter has been replaced.

Note!

New values will be learned after a period of normal operation.

Clearing Fuel Pump Learned Values

Learned Values can be cleared using a compatible scan tool or manually.

Manual Clearing:

1. Initiate Manual Fault Code Erasure
2. Learned Values will also be cleared.

Fuel Sedimentor (If Fitted)

- Early build R51 vehicles had no sedimentor.
- A Fuel Sedimentor was then located in the left rear corner of the engine compartment (R51 and on all D40).
- Later build vehicles use a combined Filter/sedimentor located on the right side of the firewall (R51 and D40).

A warning lamp will illuminate on the instrument cluster when the Sedimentor is full of water.

Note!

If the warning lamp is illuminated, water must be drained immediately to ensure injector pump is not damaged by . Early build vehicles without sedimentor, did not use a warning lamp.

Note!

*On the separate sedimentor,
loosen air bleeder screw before draining.*

Fuel Temperature Sensor

The Fuel Temperature Sensor is located at the rear of the Fuel Pump. The ECM monitors this sensor to determine the temperature of the fuel.

To Test Voltage:

See ECM Pin #A50 and A69.

Note!

The Fuel Temperature Sensor is not serviced separately from the Fuel Pump.

Fuse Locations

The following fuses are located in the Fusible Link Holder #1 at the battery post.

- Fuse Link A - 140 Amp
- Fuse Link B - 80 Amp
- Fuse Link C - 100 Amp
- Fuse Link D - 80 Amp
- Fuse Link E - 80 Amp
- Fuse Link F - 60 Amp

The following fuses are located in the Fusible Link Holder #2 at the right side of the engine compartment.

- Fuse Link I - 40 Amp
- Fuse Link N - 60 Amp
- Fuse Link J - 40 Amp

The following fuses are located in the Power Distribution Module at the left rear corner of the engine compartment.

- Fuse 42 - 10 Amp
- Fuse 49 - 10 Amp
- Fuse 53 - 20 Amp

The following fuses are located in the Instrument Panel Fuse and Box, behind the glove box door.

- Fuse 1 - 10 Amp
- Fuse 2 - 10 Amp
- Fuse 12 - 10 Amp
- Fuse 14 - 10 Amp
- Fuse 19 - 10 Amp
- Fuse 20 - 10 Amp

Glow Indicator Lamp

The Glow Indicator Lamp is located in the Instrument Cluster. The ECM commands this lamp ON when the Glow Plugs are operating. It is controlled via the CAN Communication Bus.

Glow Operation

The ECM actuates the Glow Relay to operate the Glow Plugs with the ignition ON, when cranking or running.

Dependant upon the coolant temperature, the ECM may perform an "after glow" operation.

Glow Operation:

- Ignition ON - glow time based on coolant temperature:
@ 25°C - 20 seconds
- Cranking - glow ON
- Running - time based on coolant temperature.

Glow operation is disabled when coolant temperature is above 80°C.

Glow Plugs

The Glow Plugs are located in the cylinder head. The ECM controls operation of the Glow Plugs through the Glow Relay.

To Test Resistance @ 25°C:

Disconnect wiring and test individually:

Should be 0.8 Ohms Approx.



Glow Relay

The Glow Relay is located in front of the battery on the radiator support panel. The ECM actuates this relay to control operation of the Glow Plugs.

To Test Voltage:

See ECM Pin #A37.

Heat Up Switch (If Fitted)

The Heat Up Switch is located on the lower dash panel.

It provides a fast idle speed for faster warm up.

Transmission must be in Park or Neutral and the accelerator pedal released for it to operate.

To Test Voltage"

See ECM Pin #A13.

Idle Speed (Base)

Base Idle Speed is ECM controlled and is NOT adjustable.

The ECM controls the idle speed for all conditions through fuel injector delivery.

1. Engine @ operating temperature
2. Transmission in PARK or NEUTRAL
3. All accessories OFF.

Manual and Auto Should be 750 ± 25 RPM.

Idle Vibration Reduction

These engines employ an electronic Idle Vibration Reduction strategy. The ECM will vary the amount of fuel between cylinders to provide a smoother idle.

This will need to be relearned if the battery is disconnected or repairs are made to the engine.

Ignition Key (Immobilisation - If Fitted)

The Ignition Key incorporates a Transponder which is part of the Immobilisation System.

The Transponder contains a unique electronic identification code. It communicates with the Ignition Lock Transceiver when the ignition is switched ON. The key's ID must be trained to the Body Control Module before it can start the vehicle.

Note!

Avoid interference from excessive keys and metallic objects on the same ring as the Ignition Key.

Note!

If the ECM or BCM are replaced, all keys will need to be trained. See Ignition Key Training.

Ignition Key Training (Immobilisation - If Fitted)

Training new Ignition Key Transponders can only be done with the Nissan Consult scan tool.

A PIN# is required. Only dealers can access the PIN#.

A maximum of 5 Ignition Key Transponders can be trained to the vehicle.

Ignition Lock Transceiver (Immobilisation - If Fitted)

The Ignition Lock Transceiver is located at the ignition switch. It receives Transponder code information when the ignition is switched ON.

The Transceiver is hard wired to the Body Control Module.

Ignition Relay

The Ignition Relay and diode are located in the Power Distribution Module. It supplies battery power to the Starter Motor Relay windings on vehicles with manual transmission.

Immobilisation System (If Fitted)

The "NATS" Immobilisation System (Nissan Anti Theft System) electronically immobilises the engine if attempts are made to "hot wire" or use an invalid ignition key.

NATS is automatically armed approx. 10 seconds after the ignition is switched OFF, when the Anti Theft Lamp begins to flash.

The system is disarmed if a correctly coded key is used to switch the ignition ON.

The system consists of:

- Ignition Key Transponder
- Ignition Lock Transceiver
- Body Control Module (BCM) - contains the Immobilisation System functions.
- ECM - Immobilises the engine
- Anti Theft Lamp

Immobilisation System operation:

1. The Ignition Lock Transceiver receives a signal from the key when it is turned to start.
2. The BCM verifies that the Ignition Key Transponder is valid.
3. It compares this data with values stored in the BCM.
4. If a match is made, the BCM will request the ECM to mobilise the engine.
5. If the response is incorrect, the BCM will request the ECM to immobilise the engine

This request is made via the CAN Communication Bus.

Note!

This system is independent of the remote keyless entry system.

Note!

Module Configuration and training new keys can only be done with the Nissan Consult scan tool.

A PIN# is required. Only dealers can access the PIN.

This process maintains the highest security for these vehicles.

See Ignition Key Training.

Immobilised State

If a faulty or invalid key is used to start:

1. The Body Control Module does not respond to the ECM, as it cannot validate the transponder code.
2. If the code does not match, the engine is immobilised by the ECM.
3. The Anti Theft Lamp remains ON.

If a number of attempts to start with an invalid key are made, the BCM may enter "Lock Mode" and the Nissan Consult scan tool will be required to enter a PIN# to unlock the system.

Only dealers can access the PIN#.

If the engine fails to start using a trained key:

1. Leave ignition ON for 5 seconds
2. Switch ignition OFF for 10 seconds
3. Repeat 1. and 2.
4. Start engine.

Note!

Avoid interference from excessive keys and metallic objects on the same ring as the Ignition Key.

Injection Timing

Fuel Injection Timing is computer controlled and is not adjustable.

Intake Air Temperature Sensor

The Intake Air Temperature Sensor is located in the Mass Air Flow Sensor.

To Test Voltage:

See ECM Pin #A55 and A74.

To Test Resistance:

Disconnect connector and measure across the sensor terminals:

Temperature	Resistance
@ 25°C	1.8 to 2.2 k Ohms.
@ 80°C	0.283 to 0.359 k Ohms.

Main Relay

The Main Relay is located in the Power Distribution Module.

To Test Voltage:

See ECM Pin #B24, B32, B38 and B39.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp is located in the Instrument Cluster.

Operation:

- Illuminates when the ignition is switched ON
 - Switches OFF when the engine is started
 - Flashes or stays ON continuously to indicate faults.
- It is controlled by the ECM via the CAN Communication Bus. See also Manual Codes.

Instrument Cluster

The hybrid type Instrument Cluster operates using both hard wire and Serial Communication. It is fitted with an LCD display.

Instrument Cluster ECM

The Instrument Cluster ECM is located in the Instrument Cluster. It receives data via the CAN Communication Bus and sends the appropriate signal to the lights and instruments.

Instrument Cluster Operational Test

The Instrument Cluster ECM provides an operational test of its functions without the need for a scan tool.

To enter test mode:

1. With Engine OFF - press and hold the Clock Switch button (adjacent to temperature gauge)
2. Switch ignition ON and continue to hold Clock Switch button until TEST appears in the display (approx. 7seconds)
3. Release Clock Switch button when TEST appears
4. Test mode begins in Step 1.
5. Press the Clock Switch button to advance to each step of the test.

Step#	Test Item	Function
1	Gauges	Displays "GAUGE". After 5 seconds activates a sweep of all gauges
2	LCD Display	Illuminates all segments of the LCD
3	Bulbs	Illuminates all ECM controlled lamps
4	ROM Status	Replace Cluster if "FAIL" appears
6	Memory Status	Replace Cluster if "FAIL" appears
11	Market Info	Displays "15" for Australia
12	Engine Configuration	Displays "04" (4 cyl.) or "06" (6 cyl.)
17	Speedometer	Displays vehicle speed in MPH
18	Speedometer	Displays vehicle speed in KPH
19	Tachometer	Displays Engine RPM
20	Fuel Sender	Displays indication of fuel level from: • 010 - Full • 255 - Empty
21	Coolant	Displays Engine Coolant Temperature in °C
22	Battery	Displays Battery Voltage
23	Seat Belt Buckle	Displays Driver Seat Belt Buckle Status: 1 = Buckled, 0 = Unbuckled
>53	Returns to Step 1	Switch OFF Ignition to Exit Test Mode

Note!

There are many other steps, most are for engineering purposes only. The relevant steps are listed above.

Power Distribution Module Auto Active Test

An active test of the Power Distribution Module functions can be conducted without a scan tool. This tests various relays, in particular cooling fan, A/C relay and compressor clutch circuit.

To activate test:

1. Ensure ignition is OFF
2. Close bonnet, doors (except drivers) and lift wiper arms off windscreen
3. Switch ignition ON and within 20 seconds, press driver's door switch 10 times and switch ignition OFF
4. Within 10 seconds switch ignition ON
5. Oil pressure lamp will flash - Auto Active Test begins
Cycle of functions repeats 3 times:

Mass Air Flow Sensor

The Mass Air Flow Sensor is located in the air intake duct. It is a hot wire type. It incorporates the Intake Air Temperature Sensor.

The ECM monitors this sensor to determine the mass of intake air.

To Test Voltage:

See ECM Pin #A54, A55, A73 and A74.

Neutral Position Switch (Manual)

The Neutral Position Switch is located on the right side of the manual transmission housing.

It is closed in Neutral.

To Test Voltage:

See ECM Pin #B29.

Park / Neutral Position Switch (Auto)

The Park / Neutral Position Switch is located inside the auto transmission oil pan. It is attached to the valve body. The Park / Neutral Position Switch signals are sent to the TCM. The TCM then sends a hard wired signal to the Instrument Cluster.

The Instrument Cluster sends a hard wired signal to the ECM.

To Test Voltage:

See ECM Pin #B29.

Power Distribution Module

The Power Distribution Module (PDM) is located at the left rear corner of the engine compartment.

Unclip, lift and invert to access fuses and relays.

It contains:

- Power Distribution Module ECM
- Relays
- Fuses

It will control various relays as directed by the ECM via the CAN Communication Bus.

Note!

The relays are not serviced separately from the Power Distribution Module.

Note!

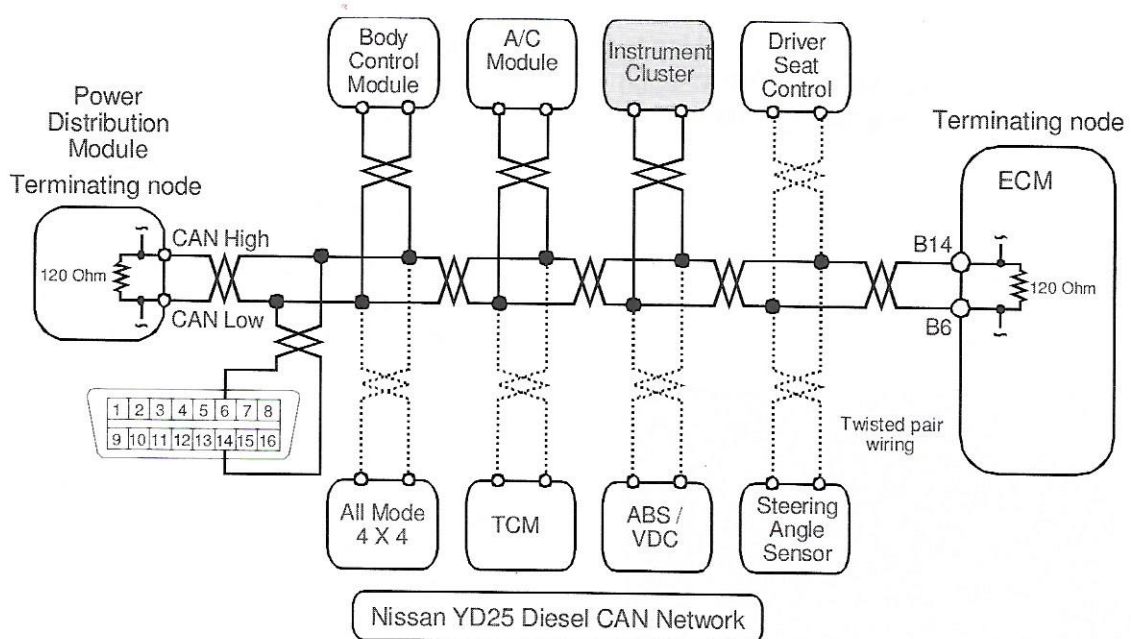
If the Ignition Relay contacts are stuck ON and the ignition is OFF, the PDM will switch on the tail lamp relay for 10 minutes to indicate a fault exists.

Test cycle:

Step#	Test Item	Operation Time / Frequency
1	Rear demister	10 seconds
2	Front wiper	Low 5 secs. - then High 5 secs.
3	Park & Fog Lamps	10 seconds
4	Headlamps	Low 10 secs. - then High ON-OFF 5 times
5	A/C Compressor	ON-OFF 5 times
6	Cooling Fan	Low 5 secs. - then High 5 secs..

Power Distribution Module ECM

The Power Distribution Module ECM is located within the Power Distribution Module. The Power Distribution Module is at one end of the CAN Serial Communication Bus and contains a Terminating Node



Serial Communication

These vehicles use BUS Communication (Bi-Directional Universal Signal). The Bus consists of a twisted pair wiring to minimise external interference.

The protocol used is Controller Area Network (CAN).

This is a high speed Class C network with a low travel time (Latency). Low latency is critical for powertrain control and vehicle dynamics.

Each module in the CAN Bus is a "node" and sends and receives messages.

The "Terminating Nodes" are inside the ECM and the Power Distribution Module. The terminating nodes contain 120 ohm resistors across each Bus wire to prevent corruption of signals. Due to more use of the CAN Bus for sourcing of signals on these vehicles, greater use of scan tools is required to read actual signal values as received by the ECM.

To Test Voltage:

See ECM Pin #B6 and B14.

Note!

If there is a break or short in the CAN network, some modules will not be able to communicate with each other.

If the CAN Bus is shorted together, to power or to ground, then all communication will cease.

Testing CAN Bus

The CAN end bus 120 Ohm resistors are located in the ECM and the Power Distribution Module

To Test Resistance:

Disconnect battery ground terminal

Measure across Diagnostic Connector terminals #6 and #14:

Should be 60 Ohms approx.

Starter Motor Relay

The Starter Motor Relay is located in the Power Distribution Module.

Models with Auto Transmissions:

The Transmission Control Module applies battery voltage to the Starter Motor Relay windings in PARK or NEUTRAL.

Models with Manual Transmissions:

The Ignition Relay applies battery voltage to the relay windings when the ignition is switched ON.

The Starter Motor Relay is switched by the Power Distribution Module ECM. The Power Distribution Module will disable this relay whenever the engine is running or it is in the Immobilised State.

Suction Control Valve

The Suction Control Valve is located at the rear of the Fuel Pump. The ECM controls Fuel Pressure through the Suction Control Valve. It is a Normally Open solenoid. It limits the inlet orifice of the Fuel Pump.

To Test Voltage:

See ECM Pin #A10 and A29.

To Test Resistance @ 20°C:

Disconnect connector and measure between terminals:

Should be 1.5 to 3.0 Ohms.

Note!

The Suction Control Valve is not serviced separately from the Fuel Pump.

Throttle Body

The Throttle Body contains the Throttle Actuator Motor and Throttle Valve. The Throttle Valve is normally in the approx. fully open position.

The Throttle Valve closes:

- Slightly at start up
- Partially during DPF regeneration (Auto)
- Fully for a few seconds when the engine is shut down.

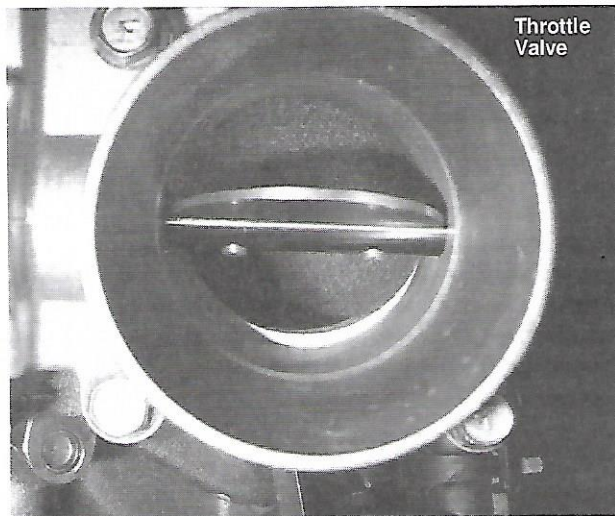
To Test Voltage:

See ECM Pin #B35 and B37.

To Test Resistance @ 25°C:

Remove connector and measure across terminals:

Should be from 0.3 to 100 Ohms.



Throttle Position Sensor

The Throttle Position Sensor is located at the Throttle Body. It is a potentiometer type sensor. It provides the ECM with feedback on actual Throttle Position.

To Test Voltage:

See ECM Pin #A64, A72 and ECM Pin #B5.

Transmission Control Module (Auto Trans)

The Transmission Control Module is located inside the auto transmission oil pan. It is attached to the valve body. It provides the Starter Relay windings with battery voltage in Park or Neutral positions.

Turbocharger

The Variable Vane turbocharger is located on the left side of the engine. Boost pressure is ECM controlled by changing the angle of the turbine feed vanes.

Turbocharger Boost Control Actuator

The Turbocharger Boost Control Actuator is located at the Turbocharger. It is operated by vacuum applied by the Turbocharger Boost Control Solenoid. It varies the angle of the turbine feed vanes.

Turbocharger Boost Control Solenoid

The Turbocharger Boost Control Solenoid is located on the left side of the engine compartment adjacent to the alternator. The ECM applies a duty cycle signal to meter vacuum through the solenoid and operate the Turbocharger Boost Control Actuator.

To Test Voltage:

See ECM Pin #A6.

Turbocharger Boost Control System

The Turbocharger Boost Control System consists of:

- Turbocharger Boost Control Actuator
- Turbocharger Boost Control Solenoid
- Turbocharger Boost Sensor
- Variable Vane Turbocharger.

Turbocharger Boost Sensor

The Turbocharger Boost Sensor is located on the right side of the intercooler. It is a Piezo pressure transducer, accessed by removing the grille. It has a rubber hose connecting it to the intercooler tank. It provides the ECM with feedback on the actual boost pressure.

To Test Voltage:

See ECM Pin #A52, A64 and A71.

Turbocharger Intercooler

The Turbocharger Intercooler is located in front of the radiator. The incoming air is compressed by the Turbocharger causing it to become heated. This air is then cooled by the Intercooler to give greater volumetric efficiency.

Turbocharger System

The Turbocharger System incorporates:

- Turbocharger
- Turbocharger Intercooler
- Turbocharger Boost Control System

Vehicle Dynamic Control (If Fitted)

These vehicles may be fitted with a Vehicle Dynamic Control System. In certain situations it helps correct understeer or oversteer. Vehicle stability is maintained by controlling engine torque and or applying brake pressure to individual wheels.

The Vehicle Dynamic Control Module is integrated with the ABS Modulator.

It incorporates:

- Anti-lock Braking System
- Electronic Brake-force Distribution
- Vehicle Dynamic Control Module.

The Vehicle Dynamic Control Module communicates with the ECM on the CAN Communication Bus to control engine torque.

Vehicle Speed Signal (VSS)

With ABS

The Vehicle Speed Signal is produced by the ABS wheel speed sensors.

The ABS ECM communicates vehicle speed to the engine ECM and the speedometer via the CAN Communication Bus.

Without ABS

Vehicle Speed Sensor is fitted to the rear of the transmission housing.

It is a variable reluctance pulse generator.

It sends a pulse to the Instrument Cluster. The instrument cluster then forwards this to the ECM via the CAN Communication Bus.

Warnings

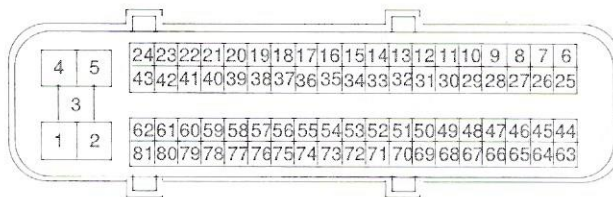
High voltages are used to operate the fuel injectors.
Ensure ignition is OFF before touching or disconnecting injector wiring.

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.
Engine idling fuel pressure will be around 27,000 kPa (4,000 psi)
It WILL reach pressures of up to 180,000 kPa (26,000 psi).

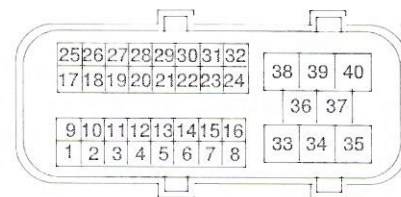
Ensure fuel pressure has dissipated before working on the fuel system.
This may take several minutes.

ECM Voltage Table

Connector A



Connector B



Nissan YD25DDTi 2.5L Diesel ECM Connectors (Back Probing View)

Connector 'A'

Pin #	Circuit and Status	Voltage
A1	ECM Ground All Times	0 Volts
A2	ECM Ground All Times	0 Volts
A3	ECM Ground All Times	0 Volts
A4	Power Supply Fuel Injector #1 and #4 Engine Cranking or Running	High Voltage Pulse
A5	Power Supply - Fuel Injector #2 and #3 Engine Cranking or Running	High Voltage Pulse
A6	Turbocharger Boost Control Solenoid Engine Running	Duty Cycle
A7	EGR Control Valve Motor Close (Auto) Engine Hot For a few seconds after switching ignition OFF	Voltage Pulses High and Low
A8	EGR Control Valve Motor Close (Auto) Engine Hot For a few seconds after switching ignition OFF	Voltage Pulses High and Low
A9	ATCP Module (If Fitted) Bus Line Positive	Data Stream
A10	Fuel Injection Pump Suction Control Valve Engine Cranking or Running	Duty Cycle
A13	Heat Up Switch (If Fitted) Ignition ON Heat Up Switch ON	Battery Volts
A17	Electronic Controlled Engine Mounting (Auto - If Fitted) Engine @ Idle Engine > 900 RPM	Low Volts Battery Volts
A18	ATCP Module (If Fitted) Bus Line Negative	Data Stream
A21	Fuel Injector #2 Engine Cranking or Running	High Voltage Pulse
A22	Fuel Injector #2 Engine Cranking or Running	High Voltage Pulse
A23	Fuel Injector #3 Engine Cranking or Running	High Voltage Pulse
A24	Fuel Injector #3 Engine Cranking or Running	High Voltage Pulse

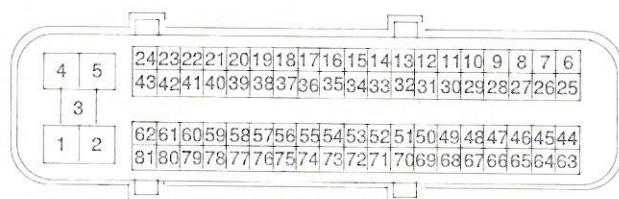
Pin #	Circuit and Status	Voltage
A25	EGR Stepper Motor (Manual) Engine Running	Voltage Pulse
A26	EGR Stepper Motor (Manual) Engine Running Voltage Pulse	
A27	EGR Stepper Motor (Manual) Engine Running	Voltage Pulse
A28	EGR Stepper Motor (Manual) Engine Running	Voltage Pulse
A29	Ground Fuel Injection Pump Suction Control Valve Engine Cranking or Running	Low Volts
A34	Electronic Controlled Engine Mounting (Manual, If Fitted) Engine @ Idle Engine > 900 RPM Battery Volts	Low Volts
A34	Air Fuel Ratio Sensor Heater Control (Auto) Ignition ON Engine Stopped Engine Idling @ Operating Temperature	Low Volts Duty Cycle
A35	ECM Ground - Air Fuel Ratio Sensor Heater (Auto) All Times	0 Volts
A37	Glow Plug Relay Ignition ON Glow Plugs OFF Glow Plugs ON	Battery Volts Low Volts
A40	Fuel Injector #4 Engine Cranking or Running	High Voltage Pulse
A41	Fuel Injector #4 Engine Cranking or Running	High Voltage Pulse
A42	Fuel Injector #1 Engine Cranking or Running	High Voltage Pulse
A43	Fuel Injector #1 Engine Cranking or Running	High Voltage Pulse
A44	Sensor Power Supply Crankshaft Position Sensor (Manual) Ignition ON	5.0 Volts Approx.
A45	Sensor Power Supply Camshaft Position Sensor Ignition ON	5.0 Volts Approx.

Connector 'A' (cont.)

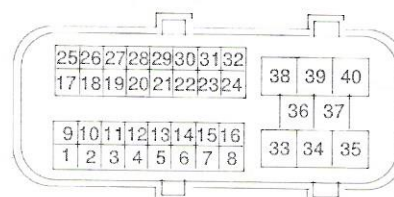
Pin #	Circuit and Status	Voltage
A46	Crankshaft Position Sensor Ignition ON Engine Cranking or Running	0 or 5.0 Volts Voltage Pulse
A47	Camshaft Position Sensor Ignition ON Engine Cranking or Running	0 or 5.0 Volts Voltage Pulse
A48	Fuel Rail Pressure Sensor Engine Hot @ Idle Engine @ 2000 RPM	1.7 to 2.0 Volts 2.0 to 2.3 Volts
A49	Fuel Rail Pressure Sensor Engine Hot @ Idle Engine @ 2000 RPM	1.7 to 2.0 Volts 2.0 to 2.3 Volts
A50	Fuel Injection Pump Temperature Sensor Engine Running	0.3 to 5.0 Volts
A51	Engine Coolant Temperature Sensor Ignition ON Temperature @ 20°C Temperature @ 50°C Temperature @ 90°C	3.8 Volts 2.6 Volts 1.3 Volts
A52	Turbocharger Boost Sensor Engine Hot @ Idle Engine @ 2000 RPM	1.8 to 2.1 Volts 2.0 to 2.3 Volts
A53	A/C Pressure Sensor Engine Running A/C Switch and Blower Switch ON	1.0 to 4.0 Volts
A54	Mass Air Flow Sensor Signal Ignition ON Engine @ Idle - Hot No Load Engine @ 4000 RPM - Hot No Load	0.4 Volts Approx. 1.3 to 1.7 Volts 4.0 Volts Approx.
A55	Intake Air Temperature Sensor Ignition ON Temperature @ 25°C Temperature @ 80°C	2.4 Volts 0.8 Volts
A56	Upstream Exhaust Gas Temperature Sensor (Auto) Exhaust Temperature @ 20°C Exhaust Temperature @ 100°C Exhaust Temperature @ 350°C Exhaust Temperature @ 550°C	5.2 Volts Approx. 5.1 Volts Approx. 3.5 Volts Approx. 2.3 Volts Approx.
A57	Downstream Exhaust Gas Temperature Sensor (Auto) Exhaust Temperature @ 20°C Exhaust Temperature @ 100°C Exhaust Temperature @ 350°C Exhaust Temperature @ 550°C	5.2 Volts Approx. 5.1 Volts Approx. 3.5 Volts Approx. 2.3 Volts Approx.
A58	Differential Exhaust Pressure Sensor (Auto) Engine @ Idle - Hot No Load Engine @ 2000 RPM - No Load	1.0 Volts Approx. 1.1 Volts Approx.
A63	Sensor Power Supply - Fuel Rail Pressure Sensor Ignition ON	5.0 Volts
A64	Sensor Power Supply Ignition ON	5.0 Volts

Pin #	Circuit and Status	Voltage
A65	Ground Crankshaft Position Sensor All Times	0 Volts
A66	Ground Camshaft Position Sensor All Times	0 Volts
A67	Ground - Sensor Shield All Times	0 Volts
A68	Ground Fuel Rail Pressure Sensor All Times	0 Volts
A69	Ground Fuel Injection Pump Temperature Sensor All Times	0 Volts
A70	Ground Engine Coolant Temperature Sensor All Times	0 Volts
A71	Ground Turbocharger Boost Sensor All Times	0 Volts
A72	Ground Sensor All Times	0 Volts
A73	Ground Mass Air Flow Sensor All Times	0 Volts
A74	Ground Intake Air Temperature Sensor All Times	0 Volts
A75	Ground Engine Compartment and Upstream Exhaust Gas Temperature Sensors (Auto) All Times	0 Volts
A76	Ground Differential Exhaust Pressure and Downstream Exhaust Gas Sensors (Auto) All Times	0 Volts
A77	Ground EGR Position Sensor (Auto) All Times	0 Volts
A79	Engine Compartment Temperature Sensor (Auto) Ignition ON Temperature @ 20°C Temperature @ 50°C Temperature @ 90°C	3.8 Volts 2.6 Volts 1.3 Volts
A81	EGR Position Sensor Signal (Auto) Engine Hot For a Few Seconds After Switching Ignition OFF Ignition OFF	0.5 to 2.5 Volts 0 Volts

Connector A

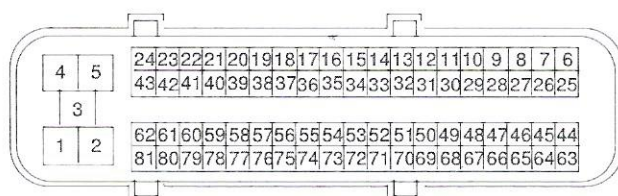


Connector B

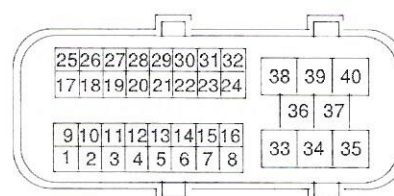


Connector 'B'

Connector A



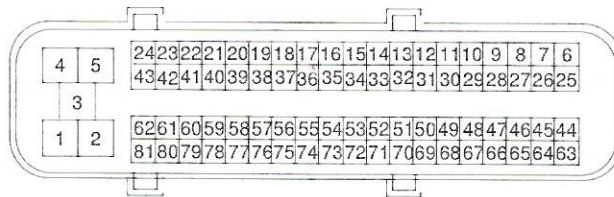
Connector B



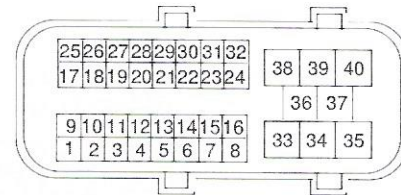
Nissan YD25DDTi 2.5L Diesel ECM Connectors (Back Probing View)

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
B1	Sensor Power Supply Ignition ON	5.0 Volts Approx.	B20	Cruise Control Brake Switch / Clutch Switch (If Fitted) Ignition ON	
B2	Accelerator Pedal Position Sensor #1 Ignition ON			Brake and Clutch Pedal at Rest	Battery Volts
	Accelerator @ Released Position	0.65 to 0.87 Volts		Brake or Clutch Pedal Depressed	Low Volts
	Accelerator @ Fully Depressed Position	> 4.3 Volts	B21	Cruise Control Switch Input (If Fitted) Ignition ON	4.0 Volts Approx.
B3	Ground Accelerator Pedal Position Sensor #1			Press RES/ACCEL	3.0 Volts Approx.
	All Times	0 Volts		Press SET/COAST	2.0 Volts Approx.
B4	Ground Accelerator Pedal Position Sensor Shield (Manual)			Press CANCEL	1.0 Volts Approx.
	All Times	0 Volts		Press MAIN	0 Volts Approx.
B4	Ground Air Fuel Ratio Sensor (Auto)		B22	Ground Cruise Control Switch (If Fitted)	
	All Times	0 Volts		All Times	0 Volts
B5	Throttle Position Sensor Signal Ignition ON	3.8 to 4.5 Volts	B24	Main Relay Control For 3 Seconds After Ignition Switched OFF	Low Volts
	Engine Idle	3.5 to 4.0 Volts		Ignition OFF	Battery Volts
	For a Few Seconds After Switching Ignition OFF	0.6 to 0.8 Volts		Ignition ON	Low Volts
B6	Serial Communication (CAN Low) Ignition ON		B26	ECM Power Supply Ignition Switch	
	Data Idle State	2.5 Volts Approx.		Ignition ON	Battery Volts
	During Data Transmission	Serial Data	B27	ECM Power Supply Ignition Switch	
B8	Diagnostic Connector Pin #7 ISO 9141 Diagnostics Line			Ignition ON	Battery Volts
	Ignition ON Battery	Volts Approx.	B29	Park / Neutral Position Switch Ignition ON	
B9	Power Supply Accelerator Pedal Position Sensor #2			Gear Selector in P or N	Low Volts
	Ignition ON	5 Volts Approx.		Any Other Position	Battery Volts
B10	Accelerator Pedal Position Sensor #2 Ignition ON		B32	Main Relay Control For 3 Seconds After Ignition Switched OFF	Low Volts
	Accelerator @ Released Position	0.28 to 0.48 Volts		Ignition OFF	Battery Volts
	Accelerator @ Fully Depressed Position	> 2.0 Volts		Ignition ON	Low Volts
B11	Ground Accelerator Pedal Position Sensor #2		B33	ECM Ground All Times	0 Volts
	All Times	0 Volts	B35	Electronic Throttle Position Motor Open	
B12	Air Fuel Ratio Sensor Signal (Auto) Engine Hot @ Idle	2.2 to 2.5 Volts		Engine Hot @ Idle	Battery Voltage
B14	Serial Communication (CAN High) Ignition ON		B37	Electronic Throttle Position Motor Close	
	Data Idle State	2.5 Volts Approx.		Engine Hot @ Idle	Battery Voltage
	During Data Transmission	Serial Data	B38	ECM Power Supply Ignition ON	Battery Volts
B18	Start Signal Ignition ON	0 Volts	B39	ECM Power Supply Ignition ON	Battery Volts
	Engine Cranking	Battery Volts	B40	Keep Alive Memory Power	
B19	Brake Lamp Switch Ignition ON			All Times	Battery Volts
	Brake Pedal at Rest	0 Volts			
	Brake Pedal Depressed	Battery Volts			

Connector A



Connector B

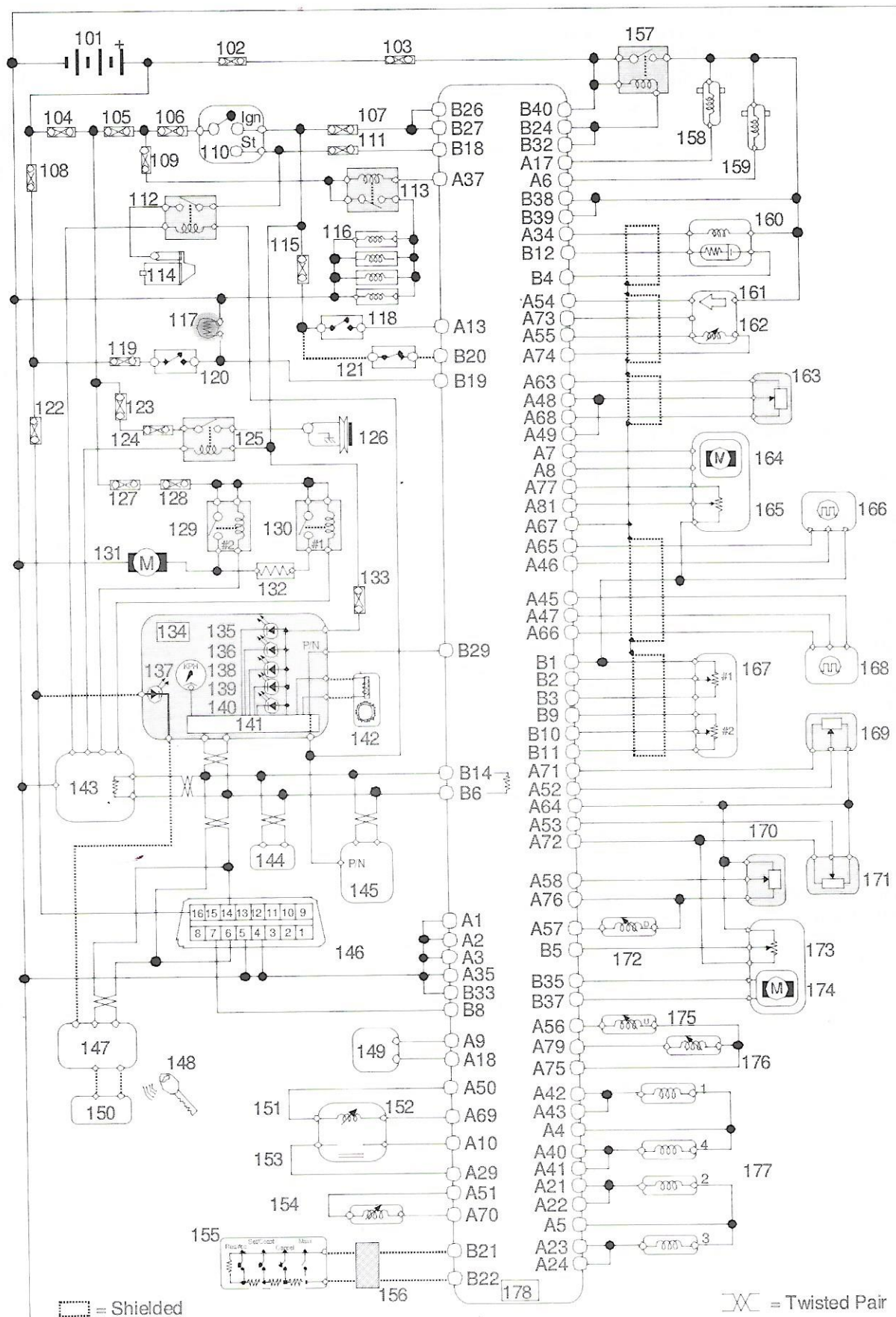


Nissan YD25DDTi 2.5L Diesel ECM Connectors (Back Probing View)

Key to Wiring Diagram (Auto) (next page)

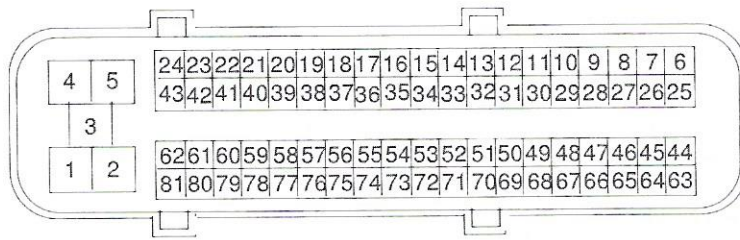
- | | | |
|--|---|--|
| 101. Battery | 129. Engine Cooling Fan Relay #2 | 155. Cruise Control Switches (If Fitted) |
| 102. Fusible Link B - 80 Amp | 130. Engine Cooling Fan Relay #1 | 156. Clockspring |
| 103. Fuse #53 - 20 Amp | 131. Engine Cooling Fan | 157. Main Relay |
| 104. Fusible Link A - 140 Amp | 132. Engine Cooling Fan Resistor | 158. Electronic Controlled Engine Mounting (If Fitted) |
| 105. Fusible Link C - 100 Amp | 133. Fuse #14 - 10 Amp | 159. Turbocharger Boost Control Solenoid |
| 106. Fusible Link J - 40 Amp | 134. Instrument Cluster | 160. Air Fuel Ratio Sensor |
| 107. Fuse #1 - 10 Amp | 135. Malfunction Indicator Lamp | 161. Mass Air Flow Sensor |
| 108. Fusible Link F - 60 Amp | 136. DPF Warning Lamp | 162. Intake Air Temperature Sensor |
| 109. Fusible Link N - 60 Amp | 137. Anti Theft Lamp (If Fitted) | 163. Fuel Rail Pressure Sensor |
| 110. Ignition Switch | 138. Glow Indicator Lamp | 164. Exhaust Gas Recirculation Valve |
| 111. Fuse #2 - 10 Amp | 139. Cruise Control On Lamp (If Fitted) | 165. Exhaust Gas Recirculation Valve Position Sensor |
| 112. Starter Motor Relay | 140. Cruise Control Set Lamp (If Fitted) | 166. Crankshaft Position Sensor |
| 113. Glow Relay | 141. Instrument Cluster ECM | 167. Accelerator Pedal Position Sensor |
| 114. Starter Motor | 142. Vehicle Speed Sensor (Without ABS) | 168. Camshaft Position Sensor |
| 115. Fuse #12 - 10 Amp | 143. Power Distribution Module | 169. Turbocharger Boost Sensor |
| 116. Glow Plugs | 144. CAN Communication Bus to remaining modules: ABS/VDC, Transfer Control Unit, A/C ECM, (Steering Angle Sensor and Driver Seat Control Unit - If Fitted). | 170. Exhaust Differential Pressure Sensor |
| 117. Brake Lamps | 145. Transmission Control Module | 171. Air Conditioner Pressure Sensor |
| 118. Heat Up Switch (If Fitted) | 146. Diagnostic Connector | 172. Downstream Exhaust Temperature Sensor |
| 119. Fuse #20 - 10 Amp | 147. Body Control Module | 173. Throttle Position Sensor |
| 120. Brake Lamp Switch | 148. Ignition Key Transponder (If Fitted) | 174. Throttle Actuator Motor |
| 121. Cruise Control Brake Switch (If Fitted) | 149. ATCP Module (If Fitted) | 175. Upstream Exhaust Temperature Sensor |
| 122. Fuse #19 - 10 Amp | 150. Ignition Lock Transceiver (If Fitted) | 176. Engine Compartment Temperature Sensor |
| 123. Fusible Link E - 80 Amp | 151. Fuel Injector Pump | 177. Fuel Injectors |
| 124. Fuse #42 - 10 Amp | 152. Fuel Temperature Sensor | 178. Electronic Control Module (ECM) |
| 125. Air Conditioner Cutout Relay | 153. Suction Control Valve | |
| 126. Air Conditioner Compressor | 154. Engine Coolant Temperature Sensor | |
| 127. Fusible Link D - 80 Amp | | |
| 128. Fusible Link I - 40 Amp | | |

Wiring Diagram—Automatic Transmission

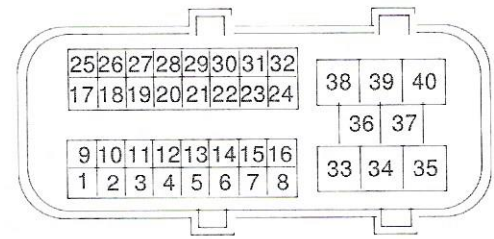


Nissan 2007 YD25DDTi 2.5L Diesel Auto. Trans. Engine Wiring Diagram

Connector A



Connector B

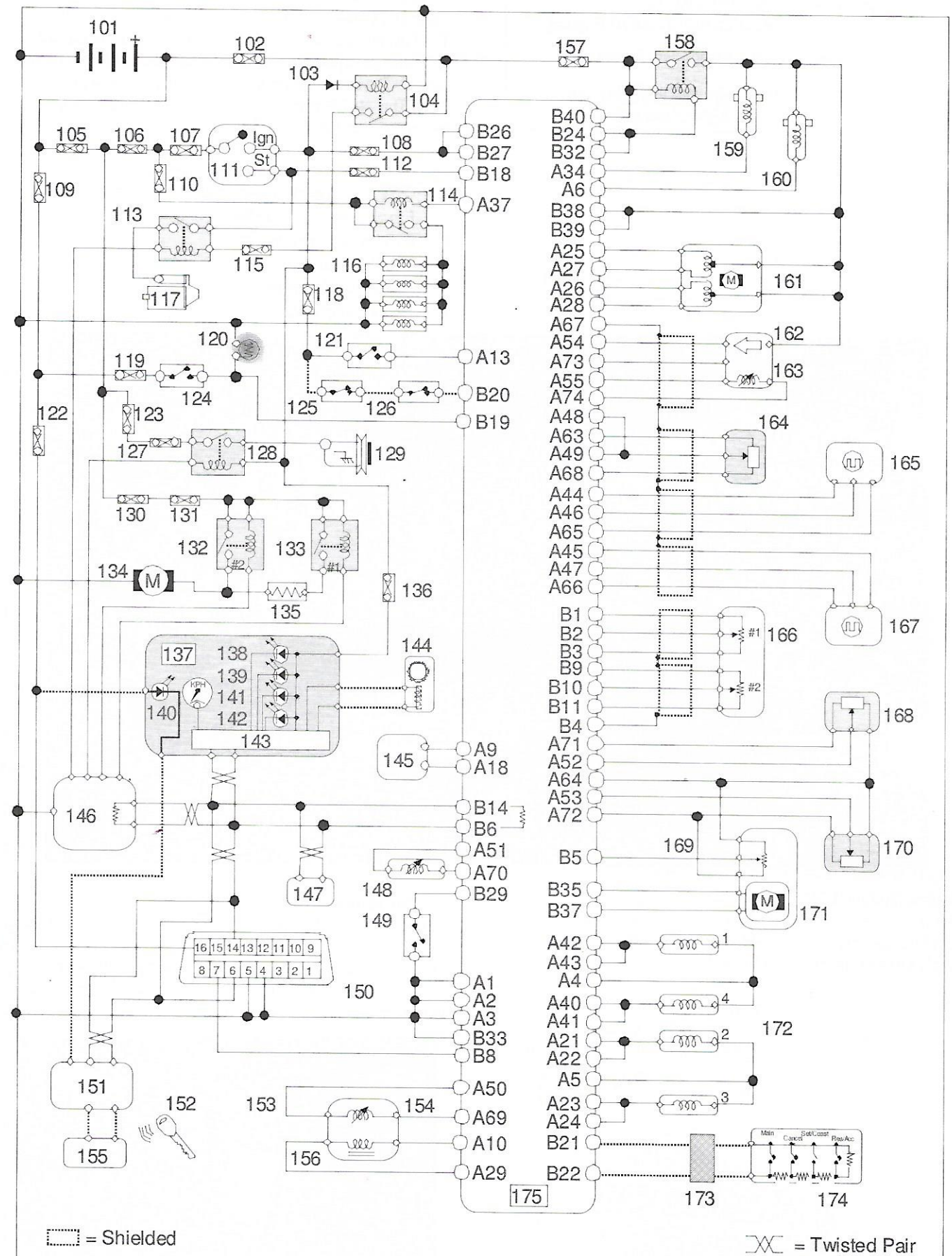


Nissan YD25DDTi 2.5L Diesel ECM Connectors (Back Probing View)

Key to Wiring Diagram, Manual (next page)

- | | | |
|---|---|--|
| 101. Battery | 128. Air Conditioner Cutout Relay | 151. Body Control Module |
| 102. Fusible Link B - 80 Amp | 129. Air Conditioner Compressor | 152. Ignition Key Transponder (If Fitted) |
| 103. Ignition Relay Diode | 130. Fusible Link D - 80 Amp | 153. Fuel Injector Pump |
| 104. Ignition Relay | 131. Fusible Link I - 40 Amp | 154. Fuel Temperature Sensor |
| 105. Fusible Link A - 140 Amp | 132. Engine Cooling Fan Relay #2 | 155. Ignition Lock Transceiver (If Fitted) |
| 106. Fusible Link C - 100 Amp | 133. Engine Cooling Fan Relay #1 | 156. Suction Control Valve |
| 107. Fusible Link J - 40 Amp | 134. Engine Cooling Fan | 157. Fuse #53 - 20 Amp |
| 108. Fuse #1 - 10 Amp | 135. Engine Cooling Fan Resistor | 158. Main Relay |
| 109. Fusible Link F - 60 Amp | 136. Fuse #14 - 10 Amp | 159. Electronic Controlled Engine Mounting (If Fitted) |
| 110. Fusible Link N - 60 Amp | 137. Instrument Cluster | 160. Turbocharger Boost Control Solenoid |
| 111. Ignition Switch | 138. Malfunction Indicator Lamp | 161. Exhaust Gas Recirculation Valve |
| 112. Fuse #2 - 10 Amp | 139. Glow Indicator Lamp | 162. Mass Air Flow Sensor |
| 113. Starter Motor Relay | 140. Anti Theft Lamp (If Fitted) | 163. Intake Air Temperature Sensor |
| 114. Glow Relay | 141. Cruise Control On Lamp (If Fitted) | 164. Fuel Rail Pressure Sensor |
| 115. Fuse #49 - 10 Amp | 142. Cruise Control Set Lamp (If Fitted) | 165. Crankshaft Position Sensor |
| 116. Glow Plugs | 143. Instrument Cluster ECM | 166. Accelerator Pedal Position Sensor |
| 117. Starter Motor | 144. Vehicle Speed Sensor (Without ABS) | 167. Camshaft Position Sensor |
| 118. Fuse #12 - 10 Amp | 145. ATCP Module (If Fitted) | 168. Turbocharger Boost Sensor |
| 119. Fuse #20 - 10 Amp | 146. Power Distribution Module | 169. Throttle Position Sensor |
| 120. Brake Lamps | 147. CAN Communication Bus to remaining modules: ABS/VDC, Transfer Control Unit, A/C ECM, (Steering Angle Sensor and Driver Seat Control Unit - If Fitted). | 170. Air Conditioner Pressure Sensor |
| 121. Heat Up Switch (If Fitted) | 148. Engine Coolant Temperature Sensor | 171. Throttle Actuator Motor |
| 122. Fuse #19 - 10 Amp | 149. Neutral Switch | 172. Fuel Injectors |
| 123. Fusible Link E - 80 Amp | 150. Diagnostic Connector | 173. Clockspring |
| 124. Brake Lamp Switch | | 174. Cruise Control Switches (If Fitted) |
| 125. Cruise Control Brake Switch | | 175. Electronic Control Module (ECM) |
| 126. Cruise Control Clutch Pedal Switch | | |
| 127. Fuse #42 - 10 Amp | | |

Wiring Diagram



Nissan 2007 YD25DDTi 2.5L Diesel Manual Trans. Engine Wiring Diagram

Manufacturer: NISSAN

Application: Patrol Y61 2007-08
3.0L I4 ZD30DDTi Diesel Engine)

Subject: Engine Management System

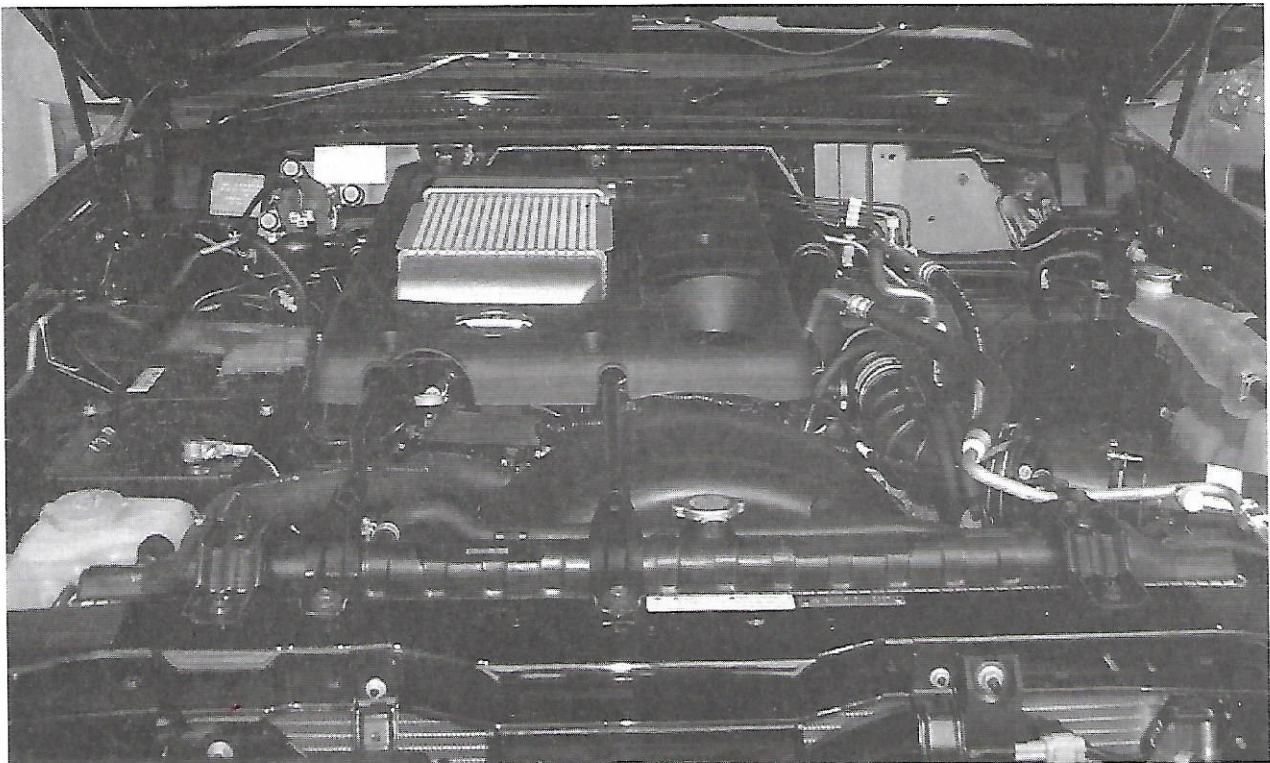
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Overview

These vehicles are fitted with a 3.0 Litre DOHC 16 valve direct injection I4 Diesel engine. A Turbocharger and Intercooler are fitted. The Bosch Common Rail fuel injection system is fitted. The Fuel Injectors are operated sequentially. Fuel is injected up to 3 times per cycle. Air mass calculation is by a Mass Air Flow Sensor. The cruise control system (If Fitted) is managed by the ECM. The "NATS" Immobilisation System is fitted to Wagon models.

The following are all electronically controlled:

- Glow Plug Control
- Exhaust Gas Recirculation
- Fuel Injector Operation
- Fuel Pressure
- Accelerator Operation
- Turbocharger Boost

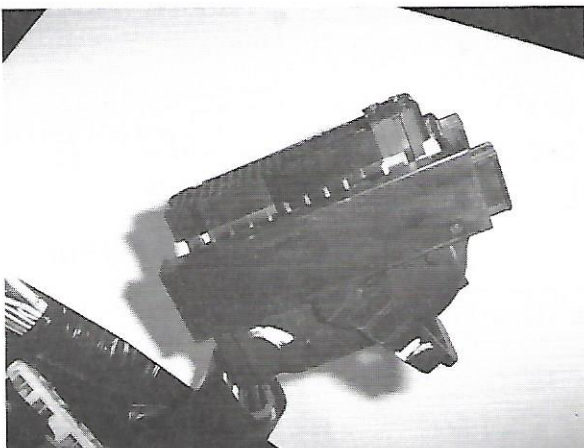


Control Module (ECM)

The two connector 154 pin ECM is located under the dash, to the left of the steering column. Swing each connector release lever inwards to release the connector.

Warning

High voltages are used to operate the fuel injectors. Ensure ignition is OFF before touching or disconnecting injector wiring.



Control Module Grounds

Key grounds for the ECM are all interconnected and attached to the body:

ECM Pins #B2, B4 and B6 are interconnected in the wiring harness – located at two ground points on the ECM mounting bracket to the left of the steering column.



Fault Codes

The Fault Codes are OBDII type. They can be accessed using a compatible scan tool.

Fault Code Erasure

Fault Codes can be erased using a compatible scan tool.

Fault Code Extraction

Fault Codes can be extracted using a compatible scan tool.

Note!

Switch OFF ignition and wait 10 seconds before running any Fault Code Extraction.

Fault Code Identification

Code #	Fault
P1089	Fuel Injector Pump Fuel Pressure is Lower Than Target Valve
P1090	Fuel Injector Pump Fuel Pressure is Higher Than Target Valve
P1276	Cylinder #1 or Cylinder #4 Fuel Injector Shorted to Ground
P1277	Cylinder #2 or Cylinder #3 Fuel Injector Shorted to Ground
P1409	EGR Control Valve Closed Position Out Of Range
P1603	ECM ROM Malfunction
P1610	NATS Immobilisation Malfunction Lock Mode Unregistered Key Used Numerous Times
P1611	NATS Immobilisation Malfunction No Key ID Code Verification
P1612	NATS Immobilisation Malfunction No Communication between ECM and BCM
P1613	NATS Immobilisation Malfunction
P1614	NATS Immobilisation Malfunction BCM Not Receiving Key ID Signal
P1615	NATS Immobilisation Malfunction Difference of Key, Unregistered Key Used
P1616	NATS Immobilisation Malfunction ECM ROM Malfunction
P1625	Fuel Injector Value Codes Not Stored in ECM
P1760	Overrun Clutch Solenoid Valve Voltage Drop Malfunction

Accelerator Pedal Position Sensor

The Accelerator Pedal Position Sensor is located at the accelerator pedal. The ECM monitors this sensor for driver demand. It uses this signal along with its other inputs to determine the amount of engine fuel required.

To Test Voltage:

See ECM Pin #A11, A15, A31, A35, A40, A64 and A89.

Accelerator System

These vehicles use a fly by wire Accelerator System without a cable.

The system incorporates:

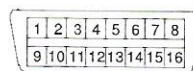
- Accelerator Pedal Position Sensor
- ECM
- Fuel Injectors.

With this system, the ECM controls the fuel delivery based on driver demand from the Accelerator Pedal Position Sensor. The system also controls idle speed and cruise control.

Diagnostic Connector

The 16 pin OBDII type Diagnostic Connector is located underneath the driver side dash.

A scan tool can be connected to this connector for diagnosis.



- 4 = Ground
- 5 = Ground
- 6 = CAN Bus High Signal from ECM Pin #B14
- 7 = ISO Diagnostic Line to ECM Pin #B8
- 8 = Ignition Power
- 14 = CAN Bus Low Signal from ECM Pin #B6
- 16 = Power Supply - Battery

Nissan Diagnostic Connector

Code #	Fault
P2100	Electronic Throttle Control Actuator Open Circuit
P2101	Electronic Throttle Control Actuator Internal Short or Open Circuit
P2102	Electronic Throttle Control Actuator Circuit Short to Ground
P2103	Electronic Throttle Control Actuator Circuit Short to Power
P2118	Electronic Throttle Control Actuator Duty Cycle Excessive
P2119	Electronic Throttle Control Actuator Return Spring Malfunction
P2135	Accelerator Pedal Position Sensor Correlation Between Sensor #1 and #2 Out of Range
P2146	Cylinder #1 or Cylinder #4 Fuel Injector Power Supply Shorted
P2149	Cylinder #2 or Cylinder #3 Fuel Injector Power Supply Shorted
P2226	Barometric Pressure Sensor Malfunction
P2228	Barometric Pressure Sensor Signal Voltage Excessively Low
P2229	Barometric Pressure Sensor Signal Voltage Excessively High
P2620	Throttle Position Sensor or Circuit Malfunction
P2621	Throttle Position Sensor or Circuit Malfunction – Signal Voltage Excessively Low
P2622	Throttle Position Sensor or Circuit Malfunction – Signal Voltage Excessively High

Note!

The Throttle Actuator Motor and Throttle Valve are NOT used for acceleration control. Their function is to reduce engine shake on shut-down.

Air Conditioner Cutout Relay

The A/C Cutout Relay is located in the Relay box on the right side of the battery. The ECM controls its operation.

To Test Voltage:

See ECM Pin #B55

Air Conditioner Control System

These vehicles may be fitted with either a Manual or Automatic Air Conditioner Control System.

The Air Conditioner Control System consists of:

- Air Conditioner Dual Pressure Switch
- A/C Amplifier, Instrument Panel A/C ON Switch and Blower Switch (Manual A/C)
- A/C Amplifier ON Switch (Auto A/C) and Cutout Relay.

Air Conditioner Dual Pressure Switch

The A/C Dual Pressure Switch is located on top of the Receiver/Drier. It creates a signal based on refrigerant pressure. Its signal is sent to the Instrument Cluster.

The Instrument Cluster sends the signal to the ECM via the CAN Communication Bus.

The ECM monitors the discharge pressure of the A/C system. It is used to interrupt system operation in the case of excessively high or low pressures.

A/C Amplifier (Manual and Auto A/C)

The A/C Amplifier and Switches are located in the instrument panel.

Air Conditioner Request Signal

The Air Conditioner Request Signal is created by operation of the:

- Instrument Panel A/C ON Switch and Blower Switch (Manual A/C)
- A/C Amplifier ON Switch (Auto A/C)

This signal is sent to the Instrument Cluster.

Request Circuit Operation:

A Voltage applied to the circuit by the Instrument Cluster is pulled Low via the A/C controls when A/C operation is requested.

The Request Signal is then sent from the Instrument Cluster to the ECM via the CAN Communication Bus.

Automatic Transmission

These vehicles may be fitted with the RE4R03A Automatic Transmission. It is controlled by a separate Auto Trans Control Module (TCM).

Auto Trans Control Module

The Transmission Control Module is located behind the left kickpanel. It receives an engine speed signal from the ECM.

To Test Voltage:
See ECM Pin #B30.

Barometric Air Pressure Sensor

The Barometric Air Pressure Sensor is incorporated within the ECM. Sensor operation can be checked with a compatible scan tool.

Brake Lamp Switch

The Brake Lamp Switch is located at the pedal cluster. The ECM monitors this switch for brake pedal application.

To Test Voltage:
See ECM Pin #B21.

Brake Switch Correlation

The ECM monitors the correlation between the Brake Lamp Switch and the Cruise Control Brake Switch (If Fitted). If it sees one of the switches change state without the other, it will log Fault Code (P0504). Check for correct operation and installation of both switches.

Camshaft Position Sensor

The Camshaft Position Sensor is located at the front of the cylinder head. It is a Hall Effect sensor. The ECM monitors this sensor for camshaft position. If the Crankshaft Position Sensor fails, the Camshaft Position Sensor serves as a back up enabling the engine to run.

To Test Voltage:
See ECM Pin #A29 and A77.

Crankshaft Position Sensor

The Crankshaft Position Sensor is located at the front of the engine block. It is above the front crankshaft pulley.

It is an inductive pulse generator.

The ECM uses this signal to determine engine speed and crankshaft position.

To Test Voltage:
See ECM Pin #A12 and A36.

To Test Resistance @ 25°C:

Disconnect connector and measure between terminals:
Should be 500 to 600 Ohms.

Cruise Control (If Fitted)

Cruise Control is carried out internally by the ECM.

The ECM controls cruise through the quantity of fuel injected.

Inputs to the Cruise Control system are:

- Cruise Control Steering Wheel Switches
- Cruise Control Brake Switch
- Cruise Control Clutch Pedal Switch.

Cruise Control Brake Switch (If Fitted)

The Cruise Control Brake Switch is located at the pedal cluster. It is a normally closed switch. The ECM monitors this switch for brake pedal application to cut out the cruise mode.

See also Brake Switch Correlation.

To Test Voltage:
See ECM Pin #B8.

Cruise Control Clutch Pedal Switch (Manual – If Fitted)

The Cruise Control Clutch Pedal Switch is located at the pedal cluster. It is a normally closed switch.

The ECM monitors this switch for clutch pedal application to cut out the cruise mode.

To Test Voltage:
See ECM Pin #B7.

Cruise Control Steering Wheel Switches (If Fitted)

The Cruise Control Switches are located on the steering wheel. They are momentary contact switches connected through the clockspring to the ECM.

The ECM monitors these switches for cruise demand. Each switch produces a different voltage level signal to request a cruise function from the ECM.

To Test Voltage:
See ECM Pin #A21 and A87.

To Test Resistance @ 20°C:

Disconnect clockspring connector and measure between terminals.

Switch Pressed	Approx. Resistance Ohms
None	4000
ACCEL/RES	1480
COAST/SET	660
CANCEL	250
ON-OFF	0

EGR System

The ECM controls the volume of exhaust gas recirculated to suit all conditions through the Exhaust Gas Recirculation (EGR) Control Valve. This reduces combustion temperatures and lowers exhaust NO_x emissions.

The system incorporates:

- EGR Valve Assembly
- EGR Valve Position Sensor.

Exhaust Gas Recirculation (EGR) Valve Assembly

The EGR Valve Assembly is located at the front of the intake manifold.

It incorporates:

- A throttle type valve to control exhaust gas flow
- A DC motor to vary the position of the valve position and rate of exhaust flow.
- The Exhaust Gas Recirculation (EGR) Valve Position Sensor.

EGR Valve Position Sensor

EGR Valve Position Sensor is a potentiometer type sensor. The ECM monitors this sensor to determine the opening of the Exhaust Gas Recirculation Valve. It provides the ECM with feedback on the actual Control Valve position.

To Test Voltage:

See ECM Pin #A38, A39, A78, A84 and A96.

To Test Motor Resistance @ 25°C:

Remove connector and measure across terminals:

Should be from 0.3 to 100 Ohms.

EGR Valve Learning

The EGR Valve requires a Closed Position Learnt Value Clearing and a Closed Position Learning procedure if:

- EGR Valve has been removed and refitted.
- EGR Valve has been replaced.
- ECM has been replaced

The Clearing procedure must be conducted using compatible scan tool.

Note!

This procedure should be conducted with the engine at normal operating temperature.

Learning Procedure:

1. Run engine to operating temperature
2. Switch the ignition OFF for 10 seconds.
3. Ensure that the EGR valve moves during the above 10 second OFF period.

Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor is located at the front of the cylinder head.

The resistance of this thermistor decreases as temperature rises. The ECM monitors this sensor to determine the engine coolant temperature. It is also used by the ECM to control electric Cooling Fan Operation.

To Test Voltage:

See ECM Pin #A59 and A85.

To Test Resistance:

Disconnect connector and measure between terminals as follows:

Temperature	Resistance
20°C	2.1 to 2.9 k Ohms
50°C	0.68 to 1.0 k Ohms
90°C	0.236 to 0.260 k Ohms

Engine Cooling Fans

These vehicles are fitted with a viscous coupling mechanical fan and an electric fan. The electric cooling fan is located in front of the radiator.

The Engine Cooling Fan Control System includes:

- Electric Cooling Fan
- Engine Cooling Fan Relay.

The ECM controls the Engine Cooling Fan Relay to operate the electric fan at a single speed.

Engine Cooling Fan Relay

The Engine Cooling Fan Relay is located in the Relay box on the right side of the battery. The ECM controls the operation of this relay.

To Test Voltage:

See ECM Pin #B42.

Engine Oil

Nissan specify a European specification oil, 10W40 ACEA B3 for ALL ZD30 engines.

This is important for engine life and correct operation of the Engine Oil Pressure Sensor.

Ensure oil change intervals are kept up to date and the correct oil is used.

Engine Oil Pressure Warning System

These engines are fitted with two Engine Oil Pressure Warning Systems:

- A conventional Engine Low Oil Pressure Switch and Engine Low Oil Pressure Lamp (red oil can)
- An additional Engine Oil Pressure Sensor that monitors oil pressure at high RPM.

Engine Low Oil Pressure Switch

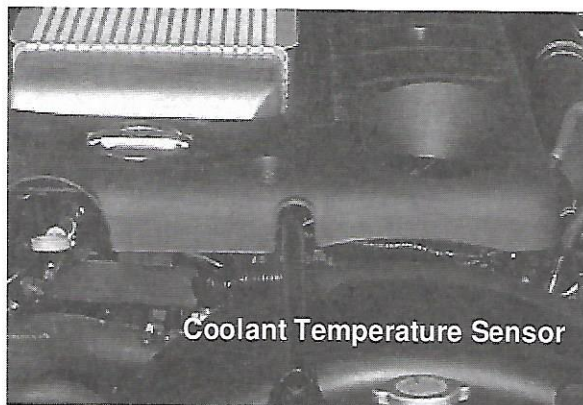
The Engine Low Oil Pressure Switch is located at the left front corner of the engine block. It is adjacent to the oil filter.

This is a conventional LOW oil pressure warning switch.

Its contacts are closed with no or low oil pressure.

It is connected directly to the Instrument Cluster.

It illuminates the Engine Low Oil Pressure Lamp if pressure falls below approx. 100 kPa.



Engine Oil Pressure Sensor

The Engine Oil Pressure Sensor is located at the right rear corner of the engine block. It is located above the starter motor. The ECM monitors oil pressure at higher engine RPM. If oil pressure is below a specified level, the ECM switches on the Engine Low Oil Pressure Lamp. This request is communicated by the ECM to the Instrument Cluster via the CAN Communication Bus.

The Engine Oil Pressure Warning System will illuminate the Engine Low Oil Pressure Lamp if the following conditions exist for more than 5 seconds:

- Engine RPM is between 3600 and 4200 RPM
- Coolant temperature < 95°C
- Engine Oil Pressure Sensor pressure < 250 KPa.

To Test Voltage:

See ECM Pin #A10, A22 and A80.

Note!

The Engine Oil Pressure Sensor location must be used for testing oil pressure with a test pressure gauge.

Exhaust Gas Control Solenoid Valve (If Fitted)

The Exhaust Gas Control Solenoid Valve is located in the left rear corner of the engine compartment. It is operated when the Heat Up Switch is activated. It operates the Exhaust Gas Control Valve (If Fitted). The Exhaust Gas Control Valve is located in the exhaust pipe. It is closed when the Heat Up system is activated. It increases backpressure in the exhaust system to speed engine warm up.

To Test Voltage:

See ECM Pin #A72.

Freeze Frame Data

If an emission related Fault Code logs, Freeze Frame Data provides a snap shot of conditions present and how the vehicle was driven at the time the Fault Code was logged. It can help isolate the cause of the Fault Code. An OBD II compatible scan tool is required to access this data.

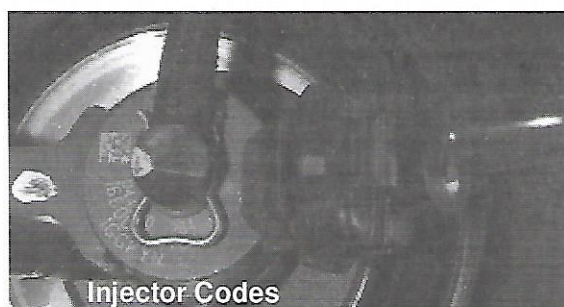
Fuel Filter and Priming Pump

The Fuel Filter and Priming Pump are located on the right side of the firewall.

It incorporates the:

- Fuel Sedimentor
- Fuel – Water Warning Lamp switch
- Fuel Recirculation Valve

To prime filter - press the Pump Bleed Bulb until it becomes firm. The Fuel Filter is replaced as an assembly which includes the Water Warning Lamp switch.



The Fuel Sedimentor

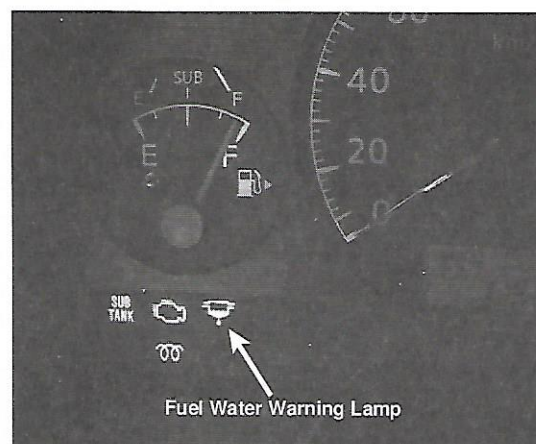
The Fuel Sedimentor must be drained every 10,000 kilometres.

Note!

If the Fuel – Water Warning Lamp is illuminated, the water must be drained immediately to ensure injector pump is not damaged by water.

Fuel Water Warning Lamp

The Fuel – Water Warning Lamp is located at the left of the Instrument Cluster. The Lamp illuminates if water accumulation is excessive. It is controlled by a switch in the base of the fuel filter / sedimentor housing.



Fuel Recirculation Valve

The Fuel Recirculation Valve is located on top of the Fuel Filter. It contains a temperature sensitive valve. It changes the path of fuel returned from the pump and injectors to avoid fuel waxing in cold temperatures. At cold temperatures, fuel returning from the injectors or pump is diverted into the filter – maintaining heat in the fuel. At higher temperatures, the return fuel is sent directly back to the tank.

Fuel Injectors

The Fuel Injectors are located in the cylinder head and protrude through the rocker cover. They are operated sequentially through an injector driver unit integrated in the ECM. Should an injector be replaced, its Fuel Injector Calibration Code must be input into the ECM.

Warning!!

The Injectors operate at approx. 80 volts. Switch ignition OFF before removing connectors.

To Test Voltage:

See ECM pin #A1, A2, A25, A26, A49, A51, A73 and A74.

To Test Resistance @ 20°C:

Disconnect connector and measure between terminals: Should be approx. 0.2 to 0.3 Ohms.

Fuel Injector Calibration Code

The Fuel Injector Calibration Code is a unique 6 digit, alphanumeric value printed on the head of each injector. Should an injector be replaced, the new injector's calibration code must be input into the ECM. Sample injector code is – C1TGMA. Should the ECM be replaced, all of the existing calibration codes must be input into the new ECM. A compatible scan tool is required to conduct this procedure. If an incorrect code is input into the ECM, The engine may rattle, idle may become rough, Engine life may be shortened.

Fuel Injector Pipes

The high pressure Fuel Injector Pipes are single use only. To ensure correct sealing, they must be replaced with new pipes if loosened or removed.

Warning!!

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.

Fuel Metering Valve

The Fuel Metering Valve is located at the rear of the Fuel Pump. The ECM controls Fuel Pressure through the Fuel Metering Valve. It is a Normally Open solenoid. It limits the fuel inlet orifice of the Fuel Pump.

To Test Voltage:
See ECM Pin #A76.

To Test Resistance @ 20°C:
Disconnect connector and measure between terminals:
Should be 2.6 to 3.5 Ohms.

Fuel Pressure

Fuel Pressure is regulated at the Fuel Pump. The ECM controls the position of the Fuel Metering Valve to obtain the desired fuel pressure. This adjusts the inlet orifice thereby controlling the availability of fuel and the resultant pressure. Fuel pressure is read only from a scan tool. Excessive fuel pressure is limited by the Fuel Pressure Relief Valve on the common rail.

- Engine idling fuel pressure will be around 30,000 to 40,000 kPa (4,350 to 5,800 psi)
- At 2000 RPM – engine hot no load, approx. 80,000 to 90,000 kPa (11,600 to 13,000 psi).
- During normal operation, it WILL reach maximum pressures of up to 160,000 kPa (23,000 psi).

Note!

Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes after the engine is switched OFF.

Fuel Pressure Relief Valve

The Fuel Pressure Relief Valve is located toward the front of the common fuel rail. It will open at approx 164,000 kPa. This will ONLY occur in extreme over fuel pressure situations. During all normal engine operation it MUST remain closed. If the Relief Valve is open, enough fuel pressure will remain in the rail to provide limp home operation only.

Note!

Do not remove valve from the common rail. If removed, the rail must be replaced as an assembly.

To Test Relief Valve:

1. Engine should be cold, remove any potential fire hazard
2. Prepare container to capture any release of fuel
3. Remove return fuel hose from Relief Valve and plug hose
4. Run engine at 2000 RPM for 5 seconds and ensure NO FUEL is released from Relief Valve
5. If Relief Valve is releasing ANY fuel, replace entire common rail assembly.

Fuel Pressure Sensor

The Fuel Pressure Sensor (Piezo electric element) is located at the rear of the common fuel rail. The ECM monitors this sensor to determine the fuel pressure.

To Test Voltage:

See ECM Pin #A8, A37 and A61.

Note!

Do not remove sensor from the common rail. If removed, the rail must be replaced as an assembly.

**Fuel Pump and Common Fuel Rail**

The mechanical Bosch Fuel Pump is located at the right front of the engine. The Common Fuel Rail is located on top of the engine.

The Fuel Pump contains:

- Lift Pump
- Three radial High Pressure pump elements
- Fuel Metering Valve.

Pressurised fuel is supplied to the common rail and from there to each Fuel Injector. Fuel Pressure is ECM controlled by the Fuel Metering Valve limiting the fuel inlet orifice of the pump.

Note!

The Fuel Pump is driven by the timing chain but is not timed to the engine.

The Common Fuel Rail contains the Fuel Pressure Relief Valve and the Fuel Pressure Sensor. It is serviced a complete assembly only.

Fuse Locations

The following fuses are located in the Fuse and Fusible Link box between the battery and the brake master cylinder.

Fuse Link A – 100 Amp
Fuse Link B – 100 Amp
Fuse Link C – 40 Amp
Fuse Link F – 80 Amp
Fuse Link G – 50 Amp
Fuse Link J – 30 Amp
Fuse 49 – 20 Amp

The following fuses are located in the Instrument Panel Fuse and Relay Box, at the right side of the dash panel.

Fuse 6 – 10 Amp
Fuse 12 – 7.5 Amp
Fuse 14 – 10 Amp
Fuse 24 – 7.5 Amp
Fuse 25 – 10 Amp
Fuse 26 – 7.5 Amp
Fuse 28 – 10 Amp

Glow Relay

The Glow Relay is located in the right rear corner of the engine compartment. The ECM actuates this relay to control operation of the Glow Plugs.

To Test Voltage:
See ECM Pin #B54.

Glow System Operation

The Glow System consists of the:

- Glow Relay
- Glow Indicator Lamp
- Glow Plugs
- ECM.

Glow Operation:

- Ignition ON - glow time based on coolant temperature - @ 20°C – approx. 3 seconds.
 - Cranking - glow ON
 - Running - "after glow" time based on coolant temperature.
- Glow operation is disabled when coolant temperature is above 40°C.

Glow Plugs

The Glow Plugs are located in the cylinder head. The ECM controls operation of the Glow Plugs through the Glow Relay.

To Test Resistance @ 25°C:
Disconnect wiring and test individually:
Should be 0.8 Ohms Approx.

NOTE!

Replace Glow Plugs if dropped from a height of more than 10 cm.

Glow Indicator Lamp

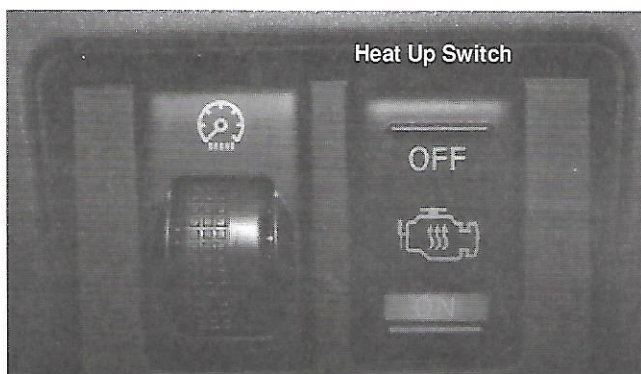
The Glow Indicator Lamp is located in the Instrument Cluster. The ECM commands this lamp ON when the Glow Plugs are operating. It is controlled via the CAN Communication Bus.

Heat Up Switch

The Heat Up Switch is located on the right side of the lower dash panel. It provides a higher idle speed for faster engine warm up. Conditions for operation are:

- Transmission must be in Park or Neutral
- Accelerator pedal released
- Coolant temperature below 105°C.

To Test Voltage:
See ECM Pin #A94.



Idle Speed (Base)

Base Idle Speed is ECM controlled and is NOT adjustable. The ECM controls the idle speed for all conditions through fuel injector delivery.

1. Engine @ operating temperature
 2. Transmission in PARK or NEUTRAL
 3. All accessories OFF.
- Manual and Auto Should be 750 ± 25 RPM.

Note!

Ensure Heat Up Switch is OFF.

Ignition Relay

The Ignition Relay is located in the Instrument Panel Fuse and Relay Box, at the right side of the dash panel. It supplies battery power to the Instrument Cluster, Heat Up Switch and Diagnostic Connector.

Immobilisation System (If Fitted)

The "NATS" Immobilisation System (Nissan Anti Theft System) electronically immobilises the engine if attempts are made to "hot wire" or use an invalid ignition key.

The system consists of:

- Ignition Key Transponder
- Ignition Lock Transceiver
- Body Control Module (BCM) - contains the Immobilisation System functions
- Anti Theft Lamp
- ECM - Immobilises the engine.

NATS is automatically armed approx. 7 seconds after the ignition is switched OFF, when the Anti Theft Lamp begins to flash.

The system is disarmed if a correctly coded key is used to switch the ignition ON.

Note!

The Immobilisation System is independent of the remote keyless entry system.

Ignition Key Transponder

The Ignition Key incorporates a Transponder which is part of the Immobilisation System. The Transponder contains a unique electronic identification code. It communicates with the Ignition Lock Transceiver when the ignition is switched ON.

The key's ID must be trained to the Body Control Module before it can start the vehicle.

Note!

Avoid interference from excessive keys and metallic objects on the same ring as the Ignition Key.

Ignition Lock Transceiver

The Ignition Lock Transceiver is located at the ignition switch. It receives Transponder code information when the ignition is switched ON. The Transceiver is hard wired to the Body Control Module.

Body Control Module

The Body Control Module is located under the dash panel on the passenger's side. It contains the Immobilisation System functions. This is the only function of the BCM on these models. It is connected to the CAN Communication Bus.

Note!

If the ECM or BCM are replaced, all keys will need to be trained.

Anti Theft Lamp

The Anti Theft Lamp red LED is located on top of the dash panel on the driver's side. It is part of the Immobilisation System (If Fitted). As a visual deterrent, the Lamp flashes every 3 seconds. It is switched by the Body Control Module.

Lamp Operation

When the ignition is switched ON, the lamp will be OFF. Approx. 7 seconds after switching the ignition OFF or to Accessory or Lock positions, the Lamp flashes every 3 seconds. If there is a fault with the Immobilisation System, the Anti Theft Lamp will remain ON.
See Immobilised State.



Immobilisation System Operation:

The Ignition Lock Transceiver receives a signal from the key when it is turned to start. The BCM verifies that the Ignition Key Transponder is valid. It compares this data with values stored in the BCM.

If a match is made, the BCM will request the ECM to mobilise the engine. If the response is incorrect, the BCM will request the ECM to immobilise the engine.

This request is made via the CAN Communication Bus.

Immobilised State

If a faulty or invalid key is used to start:

- The Body Control Module does not respond to the ECM, as it cannot validate the transponder code. If the code does not match, the engine is immobilised by the ECM.

The Anti Theft Lamp remains ON.

If a number of attempts to start with an invalid key are made, the BCM may enter "Lock Mode" and the Nissan Consult scan tool will be required to enter a PIN # to unlock the system.

Only dealers can access the PIN #.

Ignition Key Training

Training new Ignition Key Transponders can only be done with the Nissan Consult scan tool.

A PIN # is required. Only dealers can access the PIN #.

A maximum of 5 Ignition Key Transponders can be trained to the vehicle.

Injection Timing

Fuel Injection Timing is computer controlled and is not adjustable.

Instrument Cluster

The hybrid type Instrument Cluster operates using both hard wire and Serial Communication. It is fitted with an LCD display. The Instrument Cluster ECM is located in the Instrument Cluster. It receives vehicle speed and A/C request signals and communicates these to the ECM via the CAN Communication Bus.

Instrument Cluster Operational Test

The Instrument Cluster ECM provides an operational test of several functions without the need for a scan tool.

To enter test mode:

1. Switch ignition ON
2. Switch odo/trip meter to Trip A or Trip B
3. Switch ignition OFF
4. Press and HOLD the odo/trip meter button AND switch the ignition ON
5. Release the button when the trip meter displays "0000.0"
6. Within 5 seconds, press the odo/trip meter button 3 times and all segments of the LCD should display
7. Press and HOLD the odo/trip meter button and each gauge needle should move to above the horizontal position.

Replace the cluster if any of these tests indicate a fault.

Intake Air Temperature Sensor

The Intake Air Temperature Sensor is located in the Mass Air Flow Sensor.

To Test Voltage:

See ECM Pin #A47 and A60.

To Test Resistance:

Disconnect connector and measure across the sensor terminals:

Temperature	Resistance
25°C	1.8 to 2.2 k Ohms
80°C	0.283 to 0.359 k Ohms

Intake Manifold Swirl Control System

The Intake Manifold Swirl Control System consists of:

- Intake Manifold Swirl Control Valves
- Intake Manifold Swirl Control Solenoid Valve
- Vacuum Actuator Diaphragm
- Vacuum Hoses.

At low engine speeds, the system increases intake air speed by closing the Swirl Control Valves.

Swirl Control Valve operation:

RPM	Coolant Temp	Solenoid	Swirl Control Valve
< 2,600	< 21°C	OFF	Open
	22°C to 100°C	ON	Closed
	> 101°C	OFF	Open
> 2,600	-	OFF	Open

Note - If engine idles for more than 40 seconds, the Swirl Control Valve is opened.

Intake Manifold Swirl Control Valves

The 4 Intake Manifold Swirl Control Valves are located in the intake manifold. They are operated by the Vacuum Actuator Diaphragm.

Vacuum Actuator Diaphragm

The Vacuum Actuator Diaphragm is located at the rear of the intake manifold.

Intake Manifold Swirl Control Solenoid Valve

The Intake Manifold Swirl Control Solenoid Valve is located at the top of the engine on the right side.

It controls vacuum to the Vacuum Actuator Diaphragm.

To Test Voltage:

See ECM Pin #A95.



Main Relay

The Main Relay is in the Instrument Panel Fuse and Relay Box, at the right side of the dash panel.

To Test Voltage:

See ECM Pin #B1, B3, B5 and B45.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp is located in the Instrument Cluster.

Operation:

- Illuminates when the ignition is switched ON
- Switches OFF when the engine is started
- Flashes or stays ON continuously to indicate faults.

It is controlled by the ECM via the CAN Communication Bus.

Mass Air Flow Sensor

The Mass Air Flow Sensor is located in the air intake duct. It is a hot wire type. It incorporates the Intake Air Temperature Sensor. The ECM monitors this sensor to determine the mass of intake air.

To Test Voltage:

See ECM Pin #A47, A55, A60 and A82.

Neutral Position Switch (Manual)

The Neutral Position Switch is located on the side of the transmission gearshift housing. It is closed in Neutral.

To Test Voltage:

See ECM Pin #B9.

Note!

This switch is known to create problems if faulty, similar to missfire and loss of power. Try moving the gear lever slightly to see if it induces the problem. Alternatively, whilst driving the vehicle monitor the switch signal for a change of state when the problem occurs.

Serial Communication

These vehicles use BUS Communication (Bi-Directional Universal Signal). The Bus consists of a twisted pair wiring to minimise external interference. The protocol used is Controller Area Network (CAN). This is a high speed Class C network with a low travel time (Latency). Low latency is critical for powertrain control and vehicle dynamics.

Each module in the CAN Bus is a "node" and sends and receives messages.

The "Terminating Nodes" are inside the ECM and the Instrument Cluster. The terminating nodes contain 120 ohm resistors across each Bus wire to prevent corruption of signals.

Due to more use of the CAN Bus for sourcing of signals on these vehicles, greater use of scan tools is required to read actual signal values as received by the ECM.

To Test Voltage:

See ECM Pin #B35 and B36.

Note!

If there is a break or short in the CAN network, some modules will not be able to communicate with each other. If the CAN Bus is shorted together, to power or to ground, then all communication will cease.

Testing CAN Bus:

The CAN end bus 120 Ohm resistors are located in the ECM and the Instrument Cluster.

To Test Resistance:

Disconnect battery ground terminal

Measure across Diagnostic Connector terminals #6 and #14:

Should be 60 Ohms approx.

Starter Motor Inhibitor (Auto)

The Starter Motor Inhibitor function is controlled by the:

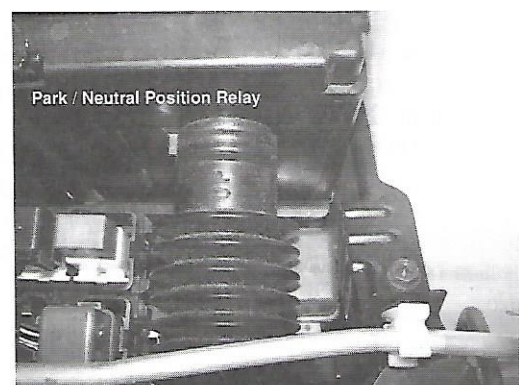
- Park / Neutral Position Switch
- Park / Neutral Position Relay.

Park / Neutral Position Switch

The Park / Neutral Position Switch is located on the right side of the auto transmission housing. It is integrated with the Transmission Gear Position Sensor. It is closed in Park and Neutral.

Park / Neutral Position Relay

The Park / Neutral Position Relay is located in the engine compartment to the right of the battery, below the battery box cooler duct. It is separate from the main relay box. It is energised in Park and Neutral.



Throttle Body

The Throttle Body is located below the intake manifold toward the rear. It contains the Throttle Actuator Motor and Throttle Valve. The Throttle Valve is normally in the approx. fully open position. The Throttle Valve closes fully for a few seconds when the engine is shut down.

To Test Voltage:

See ECM Pin #B46 and B53.

To Test Resistance @ 25°C:

Remove connector and measure across terminals:

Should be from 0.3 to 100 Ohms.

Throttle Failsafe Strategy

The ECM incorporates a throttle failsafe strategy.

If it the vehicle is being driven and:

- Vehicle speed is > 5 kph
- RPM is > 1,000
- Cruise Control is OFF
- The Accelerator pedal is depressed
- AND THEN the brake Lamp Switch signal is detected by the ECM,

The ECM will assume the throttle is jammed and within approx. 3 seconds will default the engine to idle speed. Releasing the brake pedal will restore normal engine operation. This strategy will not occur if the brake pedal is depressed first followed by application of the accelerator pedal.

Note!

Drivers using their left foot on the brake whilst pressing the accelerator with their right foot, will readily enter this mode and may consider this safety strategy to be an engine fault.

Throttle Position Sensor

The Throttle Position Sensor is located at the Throttle Body. It is a potentiometer type sensor. It provides the ECM with feedback on actual Throttle Position.

To Test Voltage:

See ECM Pin #A9, A17 and A63.

Note!

The Throttle Position Sensor requires a clearing and learning procedure if removed or replaced.

Throttle Valve, Closed Position Learnt Value Clearing

If the:

- Throttle Valve has been removed and refitted
- Throttle Valve has been replaced,

The Closed Position Learnt Value Clearing procedure must be conducted. A compatible scan tool is required to conduct this procedure.

Note!

This procedure should be conducted with the engine at normal operating temperature.

Throttle Valve, Closed Position Learning

The Throttle Valve Closed Position Learning procedure must be conducted if the:

- Throttle Valve has been removed and refitted.
- Throttle Valve has been replaced.
- ECM has been replaced

Learning Procedure:

1. Ensure Accelerator pedal is released
2. Switch the ignition ON
3. Switch ignition OFF for 10 seconds
4. Ensure that the Throttle Valve moves during the above 10 second OFF period.

Turbocharger System

The Turbocharger System incorporates:

- Variable Vane Turbocharger
- Turbocharger Intercooler
- Turbocharger Boost Control System

Turbocharger

The Variable Vane Turbocharger is located on the left side of the engine. Boost pressure is ECM controlled by changing the angle of the turbine feed vanes.

Turbocharger Intercooler

The Turbocharger Intercooler is located on top of the engine. The incoming air is compressed by the Turbocharger causing it to become heated, then cooled by the Intercooler to give greater volumetric efficiency.

Note!

Ensure all turbocharger hose connections are clean and secure

Turbocharger Boost Control System

The Turbocharger Boost Control System consists of:

- Turbocharger Boost Control Actuator
- Turbocharger Boost Control Solenoid
- Turbocharger Boost Sensor
- Variable Vane Turbocharger.

Turbocharger Boost Control Actuator

The Turbocharger Boost Control Actuator is located at the Turbocharger, operated by vacuum applied by the Turbocharger Boost Control Solenoid. It varies the angle of the turbine feed vanes.

Turbocharger Boost Control Solenoid

The Turbocharger Boost Control Solenoid is located on the left side of the engine compartment below the Mass Air Flow Sensor. The ECM applies a duty cycle signal to meter vacuum through the solenoid and operate the Turbocharger Boost Control Actuator.

To Test Voltage:

See ECM Pin #A23.

Turbocharger Boost Sensor

The Turbocharger Boost Sensor is located at the front of the intercooler. It is a Piezo pressure transducer. It provides the ECM with feedback on the actual boost pressure.

To Test Voltage:

See ECM Pin #A13, A32 and A58.

To Test Sensor @ 25°C:

1. Remove Sensor from Intercooler, leave harness connected
2. Switch ignition On, check Voltage between Terminal 2 and Ground:

Vacuum Applied	Sensor Voltage
0 KPa	2.3 Approx.
40 KPa	2.9 Approx.

Vehicle Speed Signal (VSS)

Vehicle Speed Sensor is fitted to the rear of the transfer case housing on the right side. It is a variable reluctance pulse generator. It sends a signal to the Instrument Cluster.

The instrument cluster then forwards the speed signal to the ECM via the CAN Communication Bus.

To Test

Remove sensor and rotate quickly by hand:

Should be approx 0.5 Volts AC

To Test Resistance

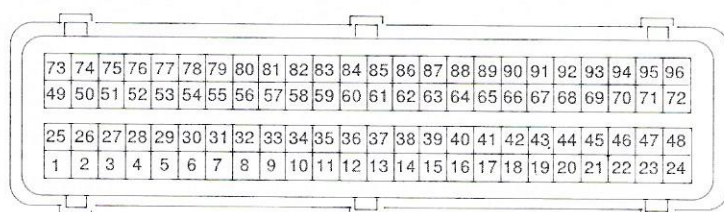
Should be approx 250 Ohms.

ECM Voltage Table**Warning!**

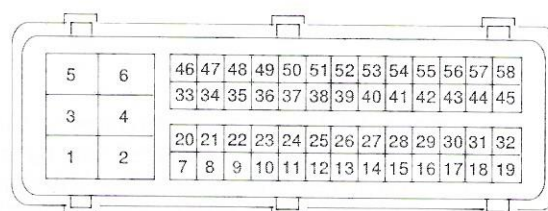
High voltages are used to operate the fuel injectors.

Ensure ignition is OFF before touching or disconnecting injector wiring.

Connector A



Connector B



Nissan Patrol ZD30 3.0L CR Diesel ECM Connectors (Back Probing View)

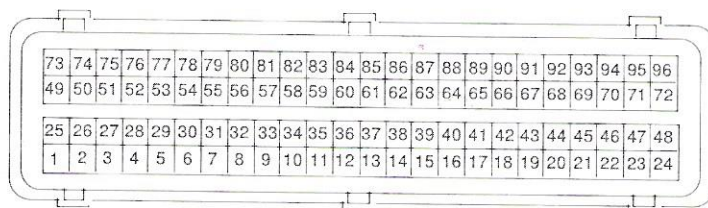
Connector 'A'

Pin #	Circuit and Status	Voltage
A1	Fuel Injector #3 Control No Specifications Available	N/A
A2	Fuel Injector #2 Control No Specifications Available	N/A
A3	ATCP Module (If Fitted) BUS Line Positive	Data Stream
A8	Sensor Ground Fuel Rail Pressure Sensor All Times	0 Volts
A9	Sensor Power Supply Throttle Position Sensor Ignition ON	5 Volts Approx.
A10	Sensor Power Supply Engine Oil Pressure Sensor Ignition ON	5 Volts Approx.
A11	Sensor Power Supply Accelerator Pedal Position #1 Ignition ON	5 Volts Approx.
A12	Sensor Ground Crankshaft Position Sensor All Times	0 Volts
A13	Sensor Power Supply Turbocharger Boost Sensor Ignition ON	5 Volts Approx.
A15	Sensor Ground Accelerator Pedal Position #2 All Times	0 Volts
A16	ATCP Module (If Fitted) BUS Line Negative	Data Stream
A17	Sensor Ground Throttle Position Sensor All Times	0 Volts
A21	Sensor Ground Cruise Control Switches All Times	0 Volts

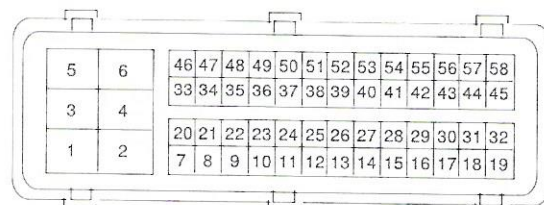
Pin #	Circuit and Status	Voltage
A22	Sensor Ground Engine Oil Pressure Sensor All Times	0 Volts
A23	Turbocharger Boost Control Solenoid Engine Running	Duty Cycle Signal
A25	Fuel Injector #1 Control No Specifications Available	N/A
A26	Fuel Injector #4 Control No Specifications Available	N/A
A29	Sensor Ground Camshaft Position Sensor All Times	0 Volts
A31	Sensor Shield Ground All Times	0 Volts
A32	Sensor Ground Turbocharger Boost Sensor All Times	0 Volts
A35	Sensor Power Supply Accelerator Pedal Position #2 Ignition ON	5 Volts Approx.
A36	Crankshaft Position Sensor Engine Running	AC Voltage Pulse
A37	Sensor Power Supply Fuel Rail Pressure Sensor Ignition ON	5 Volts Approx.
A38	Sensor Power Supply EGR Valve Position Sensor Ignition ON	5 Volts Approx.
A39	EGR Valve Motor Depending on EGR Control For a Few Seconds After Ignition Switched OFF	Voltage Pulse Voltage Pulse
A40	Sensor Ground Accelerator Pedal Position #1 All Times	0 Volts

Connector 'A' (cont.)

Connector A



Connector B



Nissan Patrol ZD30 3.0L CR Diesel ECM Connectors (Back Probing View)

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
A47	Sensor Ground		A78	Sensor Ground	
	Intake Air Temperature Sensor			EGR Valve Position Sensor	
	All Times	0 Volts		All Times	0 Volts
A49	Fuel Injector #2 Control		A80	Engine Oil Pressure Sensor	
	No Specifications Available	N/A		Ignition ON	0.3 to 0.8 Volts
A51	Fuel Injector #4 Control			Engine Hot @ Idle	1.2 Volts Approx.
	No Specifications Available	N/A		Engine @ 3600 to 4200 RPM	2.0 Volts Minimum
A55	Mass Air Flow Sensor		A82	Sensor Ground	
	Ignition ON	0.3 to 1.0 Volts		Mass Air Flow Sensor	
	Engine Hot @ Idle - No Load	1.6 to 2.3 Volts		All Times	0 Volts
	Engine Hot @ 4000 RPM - No Load	3.4 Volts Approx.	A84	EGR Valve Position Sensor	
A58	Turbocharger Boost Sensor			Engine Running	
	Engine Hot @ Idle	1.7 to 2.3 Volts		0% EGR Flow	1.0 to 1.4 Volts
	Engine Hot @ 2000 RPM	1.7 to 2.6 Volts		100% EGR Flow	3.8 to 4.2 Volts
A59	Sensor Ground		A85	Engine Coolant Temperature Sensor	
	Engine Coolant Temperature Sensor			Ignition ON	
	All Times	0 Volts		Coolant Temperature @ 20°C	3.8 Volts
A60	Intake Air Temperature Sensor			Coolant Temperature @ 50°C	2.6 Volts
	Ignition ON			Coolant Temperature @ 90°C	1.3 Volts
	Intake Air Temperature @ 25°C	2.4 Volts	A87	Cruise Control Switch	
	Intake Air Temperature @ 80°C	0.8 Volts		Ignition ON	4.3 Volts Approx.
A61	Fuel Rail Pressure Sensor			ACCEL/RES Pressed	3.3 Volts Approx.
	Engine Hot @ Idle	1.0 to 1.6 Volts		COAST/SET Pressed	2.3 Volts Approx.
	Engine Hot @ 2000 RPM	2.0 to 2.7 Volts		CANCEL Pressed	1.3 Volts Approx.
A63	Throttle Position Sensor			ON-OFF Pressed	0.3 Volts Approx.
	Engine @ Idle	4.2 Volts Approx.	A89	Accelerator Pedal Position Sensor #2	
	For a Few Seconds After Switching			Ignition ON	
	Ignition OFF	0.5 Volts Approx.		Accelerator Pedal Released	0.2 to 0.53 Volts
A64	Accelerator Pedal Position Sensor #1			Accelerator Pedal Fully Depressed	1.56 to 2.35 Volts
	Ignition ON		A92	Start Signal	
	Accelerator Pedal Released	0.4 to 1.05 Volts		Ignition ON	0 Volts
	Accelerator Pedal Fully Depressed	3.1 to 4.7 Volts		Engine Cranking	Battery Volts
A72	Exhaust Gas Control Valve (If Fitted)		A94	Heat Up Switch	
	Engine Running			Ignition ON	
	Valve Closed	0.1 Volts		Heat Up Switch OFF	0 Volts
	Valve Open	Battery Volts		Heat Up Switch ON	Battery Volts
A73	Fuel Injector #3 Control		A95	Swirl Control Valve Solenoid	
	No Specifications Available	N/A		Engine Running	
A74	Fuel Injector #1 Control			Swirl Control Valve Open	Battery Volts
	No Specifications Available	N/A		Swirl Control Valve Closed	Low Volts
A76	Fuel Pump Control Valve		A96	EGR Valve Motor	
	Engine Running	Duty Cycle Signal		During EGR Control	Voltage Pulse
A77	Camshaft Position Sensor			For a Few Seconds After Ignition Switched OFF	Voltage Pulse
	Engine Cranking or Running	Voltage Pulse			

Connector 'B'

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
B1	ECM Power Supply		B5	ECM Power Supply	
	Ignition ON	Battery Volts		Ignition ON	Battery Volts
B2	ECM Ground		B6	ECM Ground	
	All Times	0 Volts		All Times	0 Volts
B3	ECM Power Supply		B7	Clutch Pedal Switch (Manual)	
	Ignition ON	Battery Volts		Ignition ON	
B4	ECM Ground			Clutch Pedal Released	0 Volts
	All Times	0 Volts		Clutch Pedal Slightly Depressed	Battery Volts

Connector 'B' (cont.)

Pin # Circuit and Status

B8 Cruise Control Brake Switch (If Fitted)

Ignition ON

Brake Pedal Released

Brake Pedal Slightly Depressed

Battery Volts

0 Volts

B9 Neutral Position Switch (Manual)

Ignition ON

Gear Selector in NEUTRAL

Any Other Position

Low Volts

Battery Volts

B19 ECM Ignition Switch Power Supply

Ignition ON

Battery Volts

B21 Brake Lamp Switch

Ignition ON

Brake Pedal Released

Brake Pedal Slightly Depressed

0 Volts

Battery Volts

B30 Engine Speed Signal (Auto)

No Specifications Available

N/A

B35 Serial Communication (CAN Low)

Ignition ON

Data Idle State

During Data Transmission

2.5 Volts Approx.

Serial Data

Pin # Circuit and Status

B36 Serial Communication (CAN High)

Ignition ON

Data Idle State

During Data Transmission

2.5 Volts Approx.

Serial Data

B42 Cooling Fan Relay

Engine Running

Fan OFF

Fan Running

Battery Volts

Low Volts

B45 Main Relay Control

Ignition ON

Ignition OFF

Low Volts

Battery Volts

B46 Throttle Control Motor

For a Few Seconds After Ignition Switched OFF

Voltage Pulse

B53 Throttle Control Motor

For a Few Seconds After Ignition Switched OFF

Voltage Pulse

B54 Glow Plug Relay

Ignition ON

Glow Plugs OFF

Glow Plugs ON

Battery Volts

Low Volts

B55 Air Conditioner Relay

Engine Running

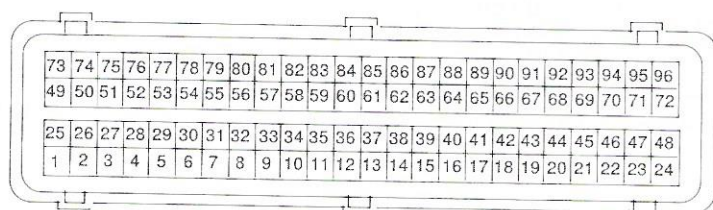
A/C OFF

A/C ON

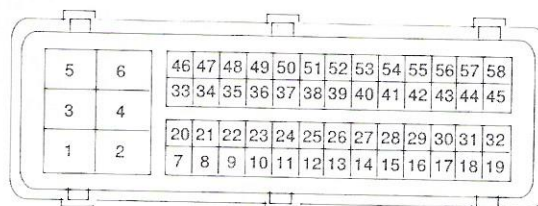
Battery Volts

Low Volts

Connector A



Connector B

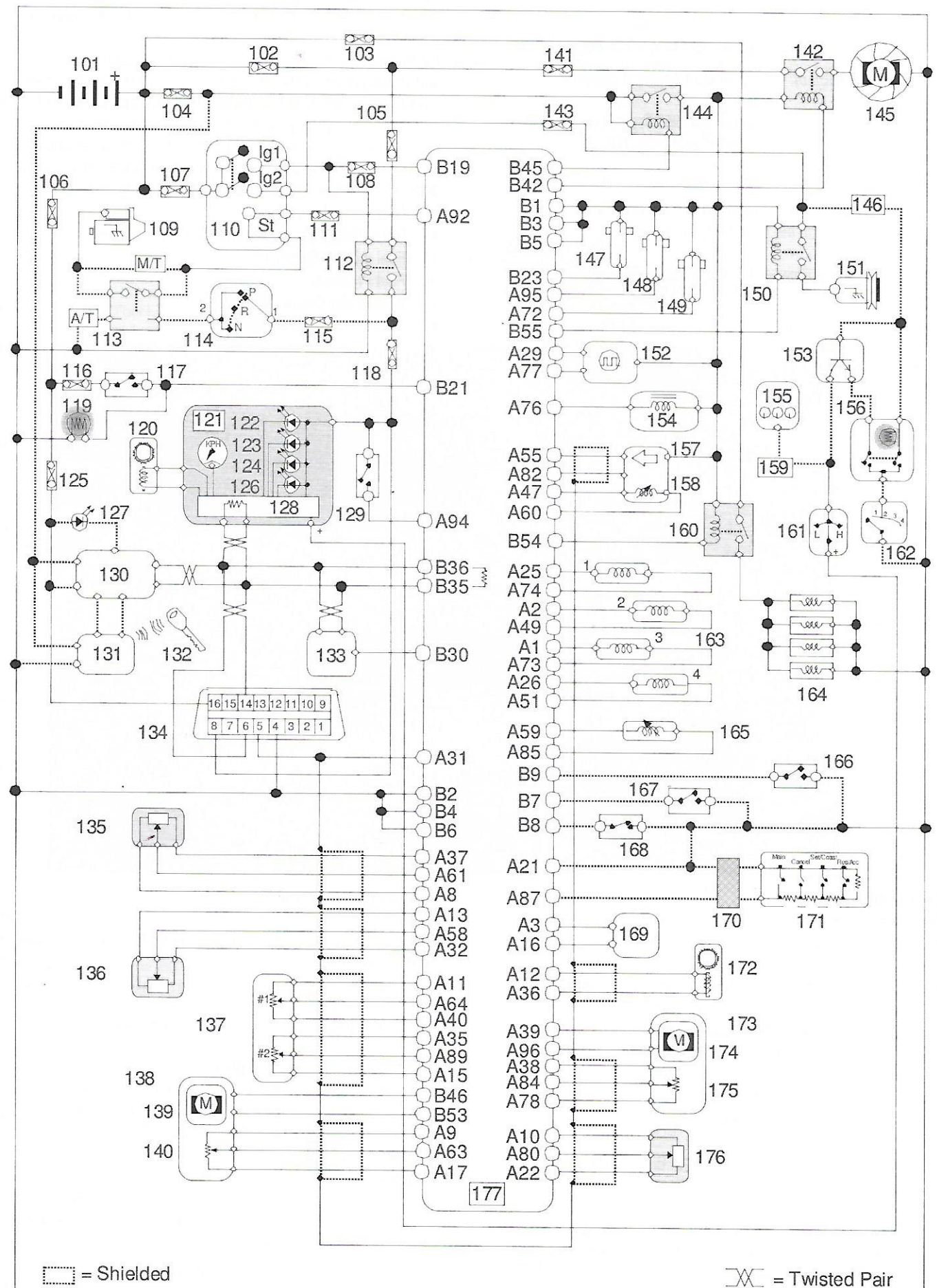


Nissan Patrol ZD30 3.0L CR Diesel ECM Connectors (Back Probing View)

Key to Wiring Diagram (next page)

101. Battery
102. Fuse Link B - 100 Amp
103. Fuse Link A - 100 Amp
104. Fuse 49 - 20 Amp
105. Fuse Link F - 80 Amp
106. Fuse Link G - 50 Amp
107. Fuse Link J - 30 Amp
108. Fuse 25 - 10 Amp
109. Starter Motor
110. Ignition Switch
111. Fuse 26 - 7.5 Amp
112. Ignition Relay
113. Park / Neutral Position Relay (Auto)
114. Park / Neutral Position Switch (Auto - Part of Trans Position Sensor)
115. Fuse 12 - 7.5 Amp
116. Fuse 14 - 10 Amp
117. Brake Lamp Switch
118. Fuse 28 - 10 Amp
119. Brake Lamps
120. Vehicle Speed Sensor
121. Instrument Cluster
122. Malfunction Indicator Lamp
123. Glow Plug Lamp
124. Cruise Control Set Lamp (If Fitted)
125. Fuse 24 - 7.5 Amp
126. Cruise Control On Lamp (If Fitted)
127. Anti Theft Lamp (If Fitted)
128. Instrument Cluster ECM
129. Heat Up Switch
130. Body Control Module (If Fitted)
131. Ignition Lock Transceiver (If Fitted - Immobilisation)
132. Ignition Key Transceiver (If Fitted - Immobilisation)
133. Transmission Control Module (Auto)
134. Diagnostic Connector
135. Fuel Rail Pressure Sensor
136. Turbocharger Boost Sensor
137. Accelerator Pedal Position Sensor
138. Throttle Body
139. Throttle Actuator Motor
140. Throttle Position Sensor
141. Fuse Link C - 40 Amp
142. Cooling Fan Relay
143. Fuse 6 - 10 Amp
144. Main Relay
145. Cooling Fan Motor
146. Manual Air Conditioning Circuit
147. Turbocharger Boost Control Solenoid
148. Intake Manifold Swirl Control Solenoid Valve
149. Exhaust Gas Control Solenoid Valve (If Fitted)
150. Air Conditioner Cut Out Relay
151. Air Conditioner Compressor
152. Camshaft Position Sensor
153. Air Conditioner Amplifier (Manual A/C)
154. Fuel Metering Valve
155. Air Conditioner Amplifier (Automatic A/C)
156. Air Conditioner On Switch (Manual A/C)
157. Mass Air Flow Sensor
158. Intake Air Temperature Sensor
159. Automatic Air Conditioning Circuit
160. Glow Plug Relay
161. Air Conditioner Dual Pressure Switch
162. Blower Control Switch (Manual A/C)
163. Fuel Injectors
164. Glow Plugs
165. Engine Coolant Temperature Sensor
166. Neutral Position Switch (Manual)
167. Cruise Control Clutch Pedal Switch (If Fitted)
168. Cruise Control Brake Switch (If Fitted)
169. ATCP Module (If Fitted)
170. Clock Spring
171. Cruise Control Switches (If Fitted)
172. Crankshaft Position Sensor
173. Exhaust Gas Recirculation Control Valve
174. Exhaust Gas Recirculation Valve Actuator Motor
175. Exhaust Gas Recirculation Valve Position Sensor
176. Engine Oil Pressure Sensor
177. Electronic Control Module

Wiring Diagram



Nissan Patrol ZD30 DDTi 3.0 L Common Rail Diesel Engine Wiring Diagram

Manufacturer: FORD

Application: FOCUS LT 2007-08
2.0L I4 (Duratorq TDCi Engine)

Subject: Engine Management System

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Note!

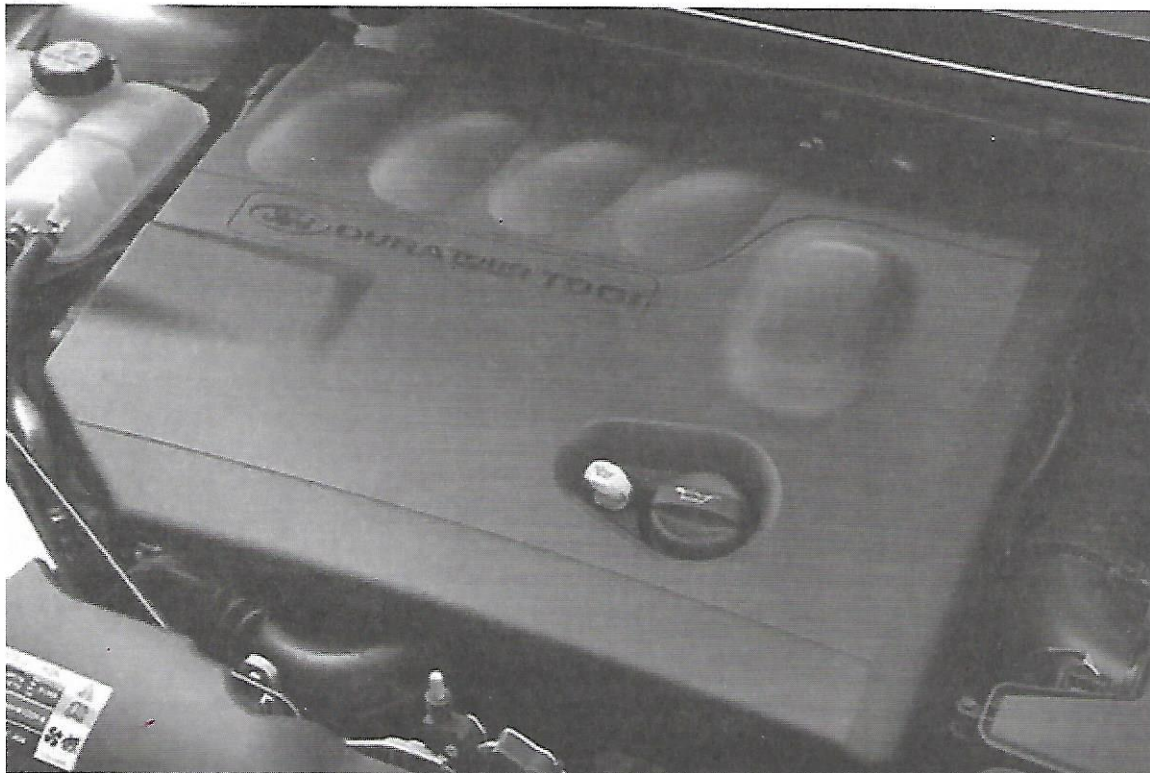
The ignition key is required to open the bonnet.
Slide the grille badge to access.

Transmission is a 6 speed Manual Trans only

Overview

These vehicles are fitted with a 2.0 Litre DOHC 16 valve direct injection I4 Diesel engine. A Turbocharger and Intercooler are fitted. The Siemens Common Rail fuel injection system with Piezo injectors is fitted. The Fuel Injectors are operated sequentially. Fuel is injected up to 3 times per cycle. Air mass calculation is by a Mass Air Flow Sensor. The cruise control system is managed by the ECM. Communication between modules is via serial data on the CAN Communication Bus. The intake manifold and rocker cover are a single piece plastic design. The following are all electronically controlled:

- Glow Plug Control
- Exhaust Gas Recirculation
- Fuel Injector Operation
- Fuel Pressure
- Accelerator Operation
- Turbocharger Boost.



Control Module (ECM)

The three connector 128 pin ECM is located in the intake resonance chamber at the left front mudguard.

To access:

- Remove the left front wheel and inner splash shield to gain access
- Remove ECM cover from resonance chamber housing
- A security cover may be fitted to the ECM.

ECM Removal (With Security Cover):

- Drill out security cover sheer bolt
- Remove security cover
- Swing each connector release lever downwards to release the connector.

Note!

Before replacing the ECM, the ECM configuration must be uploaded into the Ford IDS scan tool. This configuration information must then be downloaded into the new ECM.
Always replace sheer bolts with new sheer bolts.

Control Module Grounds

Grounds for the ECM are all interconnected in the wiring harness and attached to the body at a single point on the left side of the engine compartment.

To Test Voltage:

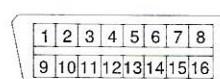
See ECM Pin # A11, B1, B5, C32, C36 and C40.

Warning

High voltages are used to operate the fuel injectors.
Ensure ignition is OFF before touching or disconnecting injector wiring.

Diagnostic Connector

The 16 pin OBDII type Diagnostic Connector is located underneath the driver side dash. A scan tool can be connected to this connector for diagnosis.



- 4 = Ground
- 5 = Ground
- 6 = CAN Bus High Signal from ECM Pin #B14
- 7 = ISO Diagnostic Line to ECM Pin #B8
- 8 = Ignition Power
- 14 = CAN Bus Low Signal from ECM Pin #B6
- 16 = Power Supply - Battery

Ford Diagnostic Connector

Fault Codes

The Fault Codes are OBDII type. They can be accessed using a compatible scan tool.

Freeze Frame Data

If an emission related Fault Code logs, Freeze Frame Data provides a snap shot of conditions present and how the vehicle was driven at the time the Fault Code was logged.

It can help isolate the cause of the Fault Code.

An OBD II compatible scan tool is required to access this data.

Fault Code Identification P1000 – ON (Model Specific)

Code #	Fault
P115A	Low Fuel Level Forced Limited Power
P115B	Low Fuel Level Forced Engine Shut Down
P1335	EGR System Fault
P1412	EGR System Fault
B1213	Number Of Programmed Keys Below Minimum (2)
B1232	PATS Transceiver Antenna Coil Fault
B1260	ECM Disabled
B1600	Non PATS Key or Damaged Key or No Key Code Received

Accelerator Control System

These vehicles use a fly by wire Accelerator Control System without a cable. With this system, the ECM controls the fuel delivery based on driver demand from the Accelerator Pedal Position Sensor. The system also controls idle speed and cruise control.

The system incorporates:

- Accelerator Pedal Position Sensor
- Instrument Cluster
- High Speed CAN Communication Bus
- ECM
- Fuel Injectors.

Note!

The Throttle Actuator Motor and Throttle Valve are NOT used for acceleration control.

Their function is to reduce engine shake on shut-down.

Accelerator Pedal Position Sensor

The dual potentiometer Accelerator Pedal Position Sensor is located at the accelerator pedal.

- The signal from one potentiometer is sent direct to the ECM.
- The signal from the other potentiometer is sent to the Instrument Cluster.

This is then sent to the ECM via the High Speed CAN Communication Bus.

The ECM monitors this sensor for driver demand. It uses this signal along with its other inputs to determine the amount of engine fuel required.

Failure Mode

If one of the sensors fail:

The engine will operate at reduced power.

Message Centre (If Fitted) displays "REDUCED POWER".

If both sensors fail:

- After a single operation of the brake switches
- Engine speed will be limited to 1200 RPM.

Fault Code Extraction

Fault Codes can be extracted using a compatible scan tool.

Fault Code Erasure

Fault Codes can be erased using a compatible scan tool.

Note!

Switch OFF ignition and wait 10 seconds before running any Fault Code Extraction.

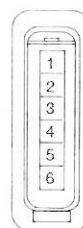
Code #	Fault
B1601	Incorrect Key Code, Unprogrammed Key
B1602	Partial Read of PATS Key Faulty Key or Transceiver
B1681	PATS Transceiver Signal is Not Received
B2103	PATS Transceiver Antenna Coil Fault
B2139	Data Mismatch Between ECM and Instrument Cluster
B2141	Non Volatile Module Configuration Failure No Exchange Between ECM and Instrument Cluster.
B2431	PATS Transponder Programming Failed
U2510	CAN Communication Link Broken Between ECM and Instrument Cluster

- Vehicle speed will be limited to 56 km/h.
- The next time the brake switches are actuated, the engine will return to idle.
- When the brake switches are released, engine speed will increase again.

Message Centre (If Fitted) displays "LIMITED MAXIMUM SPEED".

To Test Voltage:

See ECM Pin #B10.



- 1 = 5 Volts Supply from Instrument Cluster
- 2 = APPS Signal to Instrument Cluster
- 3 = Sensor Ground to Instrument Cluster
- 4 = Ground
- 5 = APPS Signal ECM Pin #B10
- 6 = Ignition Switch

Focus Diesel Accelerator Pedal Position Sensor Connector
(Backprobing View)

Air Conditioner Control System

These vehicles may be fitted with either a Manual or an Automatic Air Conditioner Control System.

The Air Conditioner Control System consists of:

- A/C Control Module (Manual or Auto)
- Dual High Pressure Switch
- Low Pressure Switch
- ECM
- Air Conditioner Cut Out Relay.

A/C Control Module

The Air Conditioner Request Signal is created by operation of the:

- A/C Control Module ON Switch and Blower Switch (Manual A/C)
- A/C Control Module ON Switch (Auto A/C) (located behind audio unit).

A/C Request Signal**Manual A/C:**

This signal is sent via a single hard wire connection to the Generic Electronic Module (GEM).

From here it is sent to the Instrument Cluster via the Medium Speed CAN Communication Bus.

The Instrument Cluster then communicates to the ECM via the High Speed CAN Communication Bus.

Auto A/C

The Auto A/C Control Module is connected directly into the Medium Speed CAN Communication Bus.

The request signal is sent on the CAN Bus to the Instrument Cluster. The Instrument Cluster then communicates to the ECM via the High Speed CAN Communication Bus.

Air Conditioner Dual High Pressure Switch

The A/C Dual High Pressure Switch is located on in the A/C high pressure pipe adjacent to the firewall at the driver's side. It creates a high or low voltage signal based on refrigerant pressure.

The ECM monitors the discharge pressure of the A/C system. It is used to interrupt system operation in the case of excessively high pressures.

To Test Voltage:

See ECM Pin #B3 and B19.

Air Conditioner Low Pressure Switch

The Air Conditioner Low Pressure Switch is located in the A/C low pressure pipe adjacent to the firewall at the driver's side. It creates a high or low voltage signal based on refrigerant pressure. The ECM monitors the suction pressure of the A/C system. It is used to interrupt system operation in the case of excessively low pressures.

To Test Voltage:

See ECM Pin #B3.

Air Conditioner Cut Out Relay

The A/C Cut Out Relay is located in the Fuse and Relay Box on the left side of the engine compartment. The ECM controls its operation.

To Test Voltage:

See ECM Pin #B17.

Alternator Control

The ECM controls Alternator output through a signal to the internal voltage regulator.

To Test Voltage:

See ECM Pin #A17 and B32.

Alternator Warning Lamp

The Alternator Warning Lamp is located on the Instrument Cluster. Its operation is controlled by the ECM. Requests are conveyed via the High Speed CAN Communication Bus.

Brake Lamp Switch

The Brake Lamp Switch is located at the pedal cluster. The ECM monitors this switch for brake pedal application.

To Test Voltage:

See ECM Pin #B13.

Camshaft Position Sensor

The Camshaft Position Sensor is located at the front of the cylinder head. It is a Hall Effect sensor.

The ECM monitors this sensor for camshaft position.

Different sized windows are machined into the back of the exhaust camshaft sprocket to identify each cylinder.

Failure Mode

If the Camshaft Position Sensor fails whilst the engine is running, the engine will continue to run.

If the sensor signal is missing during starting, the engine will not start.

To Test Voltage:

See ECM Pin #C9, C16 and C19.

Note!

Care must be taken when installing the sensor. Otherwise it will be damaged.

Installing NEW sensor:

1. Position exhaust camshaft sprocket with one of the spokes in a vertical position
2. Position the sensor so the tip is in contact with the back of the camshaft sprocket
3. Tighten retaining bolt to 2 Nm.

Installing USED sensor:

1. Position exhaust camshaft sprocket with one of the spokes in a vertical position
2. Position the sensor so the tip is in contact with the back of the camshaft sprocket
3. The sensor has a slotted mounting hole - pull the sensor back until the clearance between it and the intake manifold/rocker cover is 1.2 mm
4. Tighten retaining bolt to 2 Nm.

Crankshaft Position Sensor

The Crankshaft Position Sensor is located at the oil pump housing at the front of the engine block. It is to the right of the front crankshaft pulley. It is a Hall type sensor.

A separate timing pulley is located behind the crankshaft pulley. It has 58 magnetic pole pairs around its circumference.

The ECM uses this signal to determine engine speed and crankshaft position.

To Test Voltage:

See ECM Pin #C8, C21 and C24.

Cruise Control System

Cruise Control is carried out internally by the ECM.

The ECM controls cruise through the quantity of fuel injected.

Cruise Control Brake Pedal Switch

The Cruise Control Brake Pedal Switch is located at the pedal cluster. The ECM monitors this switch for brake pedal application to cut out the cruise mode. It is a normally closed switch. It sends its signal direct to the Instrument Cluster.

The Instrument Cluster then communicates to the ECM via the High Speed CAN Communication Bus.

Cruise Control Clutch Pedal Switch

The Cruise Control Clutch Pedal Switch is located at the pedal cluster.

The ECM monitors this switch for clutch pedal application to cut out the cruise mode. It is a normally open switch. It sends its signal direct to the Instrument Cluster. The Instrument Cluster then communicates to the ECM via the High Speed CAN Communication Bus.

Cruise Control Switches

The Cruise Control Switches are located on the steering wheel. The ECM monitors these switches for cruise demand. They are momentary contact switches connected through the clockspring to the Generic Electronic Module (GEM). From here the signals are sent to the Instrument Cluster via the Medium Speed CAN Communication Bus. The Instrument Cluster then communicates to the ECM via the High Speed CAN Communication Bus. Each switch produces a different voltage level signal to request a cruise function from the ECM.

EGR System

The ECM controls the volume of exhaust gas recirculated to suit all conditions through the Exhaust Gas Recirculation (EGR) Control Valve. This reduces combustion temperatures and lowers exhaust NO_x emissions.

The system incorporates:

- EGR Valve
- EGR Valve Position Sensor
- EGR Cooler.

EGR Valve Assembly

The Exhaust Gas Recirculation (EGR) Valve Assembly is located at the rear of the cylinder head on the right side. It incorporates:

- A motor to control exhaust gas flow
- The Exhaust Gas Recirculation (EGR) Valve Position Sensor.

To Test Voltage:

See ECM Pin #A3 and A7.

Note!

When the ignition is switched off, the EGR Valve attempts to run a cleaning cycle up to a maximum of 18 times. If it does all 18 cycles, it means that the cleaning is not working properly and the valve should be replaced.

EGR Valve Position Sensor

The Exhaust Gas Recirculation (EGR) Valve Position Sensor incorporated within the Exhaust Gas Recirculation Valve Assembly. It is a potentiometer type sensor. The ECM monitors this sensor to determine the opening of the Exhaust Gas Recirculation Valve. It provides the ECM with feedback on the actual Control Valve position.

To Test Voltage:

See ECM Pin #A31, A35 and A38.

EGR Valve - Closed Position Learning

The EGR Closed Position Learning procedure must be conducted if the:

- EGR Valve has been removed and refitted.
- EGR Valve has been replaced.
- ECM has been replaced.

The Ford IDS scan tool is required for this operation.

Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor is located in the thermostat housing at the rear of the cylinder head. It is secured in the plastic thermostat housing by a clip. The resistance of this thermistor decreases as temperature rises. The ECM monitors this sensor to determine the engine coolant temperature. It is also used by the ECM to control Engine Cooling Fan Operation.

To Test Voltage:

See ECM Pin #C2 and C25.

Engine Cooling Control System

The Engine Cooling Control system consists of:

- Engine Cooling Fan Control
- Engine Coolant Control.

Engine Cooling Fan Control

These vehicles are fitted with an electric cooling fan. The electric fan is located at the radiator shroud. The ECM controls the Engine Cooling Fan Module to operate the electric fan at variable speeds.

Engine Cooling Fan Module

The Engine Cooling Fan Module is located at the radiator fan housing. The ECM controls its operation.

To Test Voltage:

See ECM Pin #B27.

Engine Coolant Control

In addition to a conventional thermostat, the engine cooling system may contain up to two ECM controlled solenoids that improve engine warm up time.

- The Cooling System Bypass Solenoid Valve (If Fitted) limits coolant flow to the water pump during warm up. This causes most of the coolant to flow through the heater core, flowing back to the block via the EGR cooler.
- The Cooling System Shutoff Solenoid Valve (If Fitted) limits coolant flow to the coolant reservoir during warm up.

Cooling System Bypass Solenoid Valve (If Fitted)

The Cooling System Bypass Solenoid Valve is located in the thermostat housing at the rear of the cylinder head.

To Test Voltage:

See ECM Pin #A16.

To Test Solenoid:

1. Remove Bypass Solenoid
2. Connect one terminal to Ground
3. Connect other terminal to fused power supply
4. Ensure that piston moves fully into the valve
5. Ensure that it returns fully when the power is removed.

Cooling System Shutoff Solenoid Valve (If Fitted)

The Cooling System Shutoff Solenoid Valve is located adjacent to the air filter housing. It is in the coolant feed from the thermostat housing to the coolant reservoir.

The ECM controls its opening via a duty cycle signal.

To Test Voltage:

See ECM Pin #A24.

To Test Solenoid:

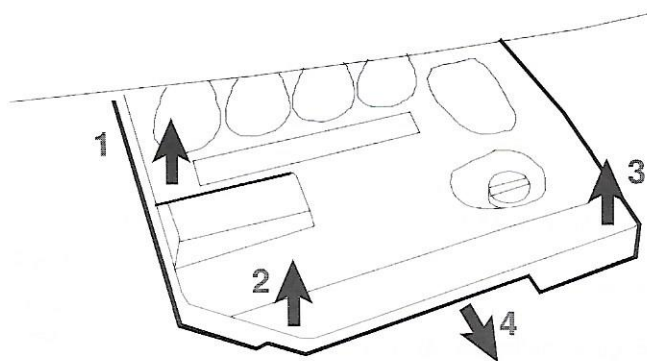
1. Remove Shut Off Solenoid
2. Connect one terminal to Ground
3. Connect other terminal to fused power supply
4. Ensure that no water can flow through the valve
5. Ensure that water can flow when the power is removed.

Engine Cover

The Engine Cover is attached by three ball clips.

The clips are angled backwards by about 20°.

To avoid damage, carefully remove cover in the following sequence:



Focus Diesel Engine Cover Removal

Note!

Apply soap solution to ball clip mountings when refitting

Engine Low Oil Pressure Switch

The Engine Low Oil Pressure Switch is located on the right side of the engine block at the oil filter housing.

The switch closes when oil pressure is below 50 KPa.

Low oil pressure status is conveyed from the ECM to the Instrument Cluster via the High Speed CAN Communication Bus.

To Test Voltage:

See ECM Pin #C23.

Firing Order

Firing Order is 1 – 3 – 4 – 2.

Note!

Cylinder #1 is at the flywheel end of the engine

Fuel Filter Assembly

The Fuel Filter Assembly is located at the left side of the cylinder head above the alternator. It is contained within a crash protection housing.

It incorporates the:

- Fuel - Water Warning Lamp Switch
- Fuel Recirculation Valve
- Fuel Heater.

The crash protection bracket must be removed to gain access.

The filter is replaced as an assembly and contains the water warning switch and heating element.

Note!

If the Fuel – Water Warning Lamp is illuminated, the water must be drained immediately to ensure the injector pump is not damaged by water.

Fuel – Water Warning Lamp Switch

The Fuel - Water Warning Lamp Switch is located in the base of the Fuel Filter. It signals the ECM if water accumulation reaches approx. 90 ml.

To Test Voltage:

See ECM Pin #C30.

Fuel – Water Warning Lamp

The Fuel - Water Warning Lamp is located on the Instrument Cluster. Water must be drained immediately this lamp illuminates.

The signal is communicated from the ECM to the Instrument Cluster via the High Speed CAN Communication Bus.

Fuel Recirculation Valve

The Fuel Recirculation Valve is located on top of the Fuel Filter. It contains a temperature sensitive valve. It changes the path of fuel returned from the pump and injectors to avoid fuel waxing in cold temperatures.

Below 15°C, fuel returning from the injectors or pump is diverted into the filter – maintaining heat in the fuel.

At higher temperatures, the return fuel is sent directly back to the tank.

Fuel Heater

A Fuel Heater Element is installed at the fuel inlet to the filter. This assists in cold running in extreme climates.

The heating element is controlled by the Fuel Heater Relay.

The Fuel Heater Relay is located in the Fuse and Relay Box on the left side of the engine compartment. It is switched by the Ignition Switch.

Fuel Filter Bleeding

When the Fuel Filter is replaced, it must be bled with a hand pressure pump. This is a special tool that is fitted for the operation and then removed.

Tool number is 310-110.

Fuel Injectors

The Fuel Injectors are located in the cylinder head.

The Piezo type injectors provide rapid opening and closing actions.

They are operated sequentially through an injector driver unit integrated in the ECM:

- A pulse is applied by the ECM to open each injector
- A pulse is applied in the reverse direction to close the injectors.

Should an injector be replaced, its Fuel Injector Calibration Code must be input into the ECM.

Warning!!

The Injectors operate at approx. 140 volts with around 7 Amps of current flow. Switch ignition OFF before removing Injector connectors.

Do not remove injector harness connectors when the engine is running. This can cause an injector to remain open. This may cause continuous injection and cause engine damage.

To Test Voltage:

See ECM pin #C41, C42, C43, C44, C45, C46, C47 and C48.

Fuel Injector Calibration Code

The Fuel Injector Calibration Code is a single digit printed on the head of each injector.

During manufacture each injector is calibrated into one of three grades (4, 5 or 6). All four injectors in an engine must have the same grade.

Should an injector be replaced, the new injector's calibration code must be input into the ECM. Should the ECM be replaced, all of the existing calibration codes must be input into the new ECM.

A compatible scan tool is required to conduct this procedure.

If an incorrect code is input into the ECM;

- The engine may rattle
- Engine idle may become rough
- Engine life may be shortened.

Injector Installation

The Piezo fuel Injectors must be Angle Torqued:

1. Torque to 4 Nm
2. Angle Torque a further 45 degrees.

Fuel Injector Pipes

The high pressure Fuel Injector Pipes are single use only.

They must NOT be reused.

To ensure correct sealing, they must be replaced with new pipes if loosened or removed.

Warning!!

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.

Injection Timing

Fuel Injection Timing is ECM controlled and is not adjustable.

Multiple injections occur during various driving modes:

- Pre Injection (reduces combustion noise and emissions).
- Main Injection
- Post Injection.
-

Fuel Pressure

Fuel Pressure is regulated at the Fuel Pump via the Fuel Metering Valve.

Fuel pressure must be at least 15,000 KPa to start the engine.

During normal operation it will range from 35,000 to 165,000 KPa (24,000 PSI). Fuel pressure is read only from a scan tool.

Note!

Ensure fuel pressure has dissipated before working on the fuel system. This may take several minutes after the engine is switched OFF.

Fuel Pressure Sensor

The Fuel Pressure Sensor (Piezo electric element) is located at the centre of the common fuel rail.

The ECM monitors this sensor to determine the fuel pressure.

To Test Voltage:

See ECM Pin #C4, C6 and C7.

Note!

Do not remove sensor from the common rail. If removed, the rail must be replaced as an assembly

Fuel Pump and Common Rail

The mechanical Siemens Fuel Pump is located at the rear of the cylinder head on the right side. It is driven by the exhaust camshaft.

It contains:

- Vane type Lift Pump
- Three radial High Pressure pump elements
- Fuel Metering Valve
- Fuel Pressure Solenoid.

Pressurised fuel is supplied to the common rail and from there to each Fuel Injector.

Fuel Pressure is ECM controlled by the Fuel Metering Valve limiting the fuel inlet orifice of the pump.

Note!

The Fuel Pump is driven by the exhaust camshaft but is not timed to the engine

Common Fuel Rail

The Common Fuel Rail is located to the left of the cylinder head below the intake manifold. It contains the Fuel Pressure Sensor.

Fuel Metering Valve

The Fuel Metering Valve is located at the upper rear of the Fuel Pump. The ECM controls Fuel Pressure through the Fuel Metering Valve. It is a Normally Closed solenoid.

It limits the fuel inlet orifice between the Lift Pump and the pump high pressure elements.

To Test Voltage:

See ECM Pin #A1.

Fuel Pressure Control Valve

The Fuel Pressure Control Valve is located at the lower rear of the Fuel Pump. It is located at the high pressure outlet of the pump. It also acts as a damper to the high pressure fuel supply.

To Test Voltage:

See ECM Pin #A5.

Fuel Temperature Sensor

The Fuel Temperature Sensor is located below the intake manifold. It is fitted to a T piece in the return fuel lines from the injectors and the pump.

The housing acts as a venturi, assisting in the return of fuel from the injectors. The ECM makes corrections to fuel injection based on fuel temperature.

To Test Voltage:

See ECM Pin #C3 and C33.

Fuse Locations

The following fuses are located in the Fuse and Relay Box on the left side of the engine compartment.

- Fuse 1 – 60 Amp
- Fuse 3 – 60 Amp
- Fuse 6 – 60 Amp
- Fuse 9 – 20 Amp
- Fuse 11 – 20 Amp
- Fuse 13 – 20 Amp
- Fuse 24 – 15 Amp
- Fuse 25 – 10 Amp
- Fuse 27 – 10 Amp
- Fuse 30 – 3 Amp

Fuse 34 – 10 Amp
 Fuse 35 – 10 Amp
 Fuse 36 – 10 Amp

The following fuses are located in the Instrument Panel Fuse Box.

This is located in the Generic Electronic Module (GEM) housing behind the glovebox.

To access fuses:

1. Remove screws in instrument panel trim below the glove box and allow trim to drop down
2. Loosen Quick Fit screws on fuse box
3. Lower fuse box down and toward you.

Fuse 44 – 10 Amp
 Fuse 67 – 10 Amp
 Fuse 74 – 15 Amp
 Fuse 75 – 10 Amp.

Generic Electronic Module

The Generic Electronic Module (GEM) is located behind the glovebox.

It is integrated with the Instrument Panel Fuse Box.

Functions include:

- Cruise Control Switch input
- Manual Air Conditioner Switch input
- Communicates to other modules via the Medium Speed CAN Communication Bus.

Glow System Operation

The Glow System consists of the:

- Glow Control Module
- Glow Indicator Lamp
- Glow Plugs
- ECM.

Glow Plug Control Module

The Glow Plug Control Module is located on the left side of the engine compartment.

The ECM controls Glow Plug operation via this module.

To Test Voltage:

See ECM Pin #A32 and A33.

Glow Indicator Lamp

The Glow Indicator Lamp is located in the Instrument Cluster. The ECM commands this lamp ON when the Glow Plugs are operating. It is controlled via the High Speed CAN Communication Bus.

Glow Plugs

The Glow Plugs are located in the cylinder head. The ECM controls operation of the Glow Plugs through the Glow Plug Control Module.

Glow Operation:

- Ignition ON - glow time based on coolant temperature
 - Cranking - glow ON
 - Running - "after glow" time based on coolant temperature.
- Glow operation is disabled approx. 30 seconds after starting and when engine RPM exceeds 2500.

Idle Speed (Base)

Base Idle Speed is ECM controlled and is NOT adjustable.

The ECM controls the idle speed for all conditions through fuel injector delivery.

1. Engine @ operating temperature
 2. Transmission in NEUTRAL
 3. All accessories OFF.
- Should be 750 RPM.

Immobilisation System

The PATS Immobilisation System electronically immobilises the engine if attempts are made to "hot wire" or use an invalid ignition key.

The PATS system consists of:

- Ignition Key Transponder
- Ignition Lock Transceiver
- Instrument Cluster - contains the Immobilisation System functions
- Anti Theft Lamp
- ECM – immobilises the engine.

PATS is automatically armed approx. 5 seconds after the ignition is switched OFF, when the Anti Theft Lamp begins to flash.

The system is disarmed if a correctly coded key is used to switch the ignition ON.

Note!

The Immobilisation System is independent of the remote keyless entry system.

Ignition Key Transponder

The Ignition Key is a flat flip retractable blade type.

It incorporates a Transponder which is part of the PATS Immobilisation System.

The Transponder contains a unique electronic identification code. It communicates with the Ignition Lock Transceiver when the ignition is switched ON.

The key's ID must be trained to the PATS System before it can start the vehicle.

Note!

Avoid interference from excessive keys and metallic objects on the same ring as the Ignition Key.

Ignition Lock Transceiver

The Ignition Lock Transceiver is located at the ignition switch. It receives Transponder code information when the ignition is switched ON. The Transceiver is hard wired to the Instrument Cluster.

Instrument Cluster

The Instrument Cluster contains the Immobilisation System functions. It is connected to the ECM via the High Speed CAN Communication Bus.

Note!

If the Instrument Cluster or the ECM are replaced, the modules will need to be initialised and all keys will need to be trained.

PATS Anti Theft Lamp

The red Anti Theft Lamp is located on the Instrument Cluster. It is part of the Immobilisation System.

As a visual deterrent, the Lamp flashes every 2 seconds. It is switched by the Instrument Cluster.

Lamp Operation

Approx. 5 seconds after switching the ignition OFF or to Accessory or Lock positions, the Lamp flashes every 2 seconds. If there is a fault with the Immobilisation System, the Anti Theft Lamp will flash at 4 Hz for 1 minute. It will then output a 2 digit error code.

Lamp Flash Codes:

11	Transceiver not connected or has no power
12	Transceiver fault
13	No key or no PATS key has been used to turn ignition switch
14	Incomplete key code received
15	Invalid key code received
16	CAN communications error
21	Not enough keys programmed – minimum 2
22	Non volatile memory configuration error
23	Codes for ECM and Instrument Cluster do not agree

Lamp Flash Display Format:

- 1st digit
- 1 second pause
- 2nd digit
- 3 second pause
- Repeats code/s.

Immobilisation System operation:

- The Ignition Lock Transceiver receives a signal from the key when it is turned to start.
- The Instrument Cluster verifies that the Ignition Key Transponder is valid.
- It compares this data with values stored in the Instrument Cluster and the ECM.
- If a match is made, the Instrument Cluster will request the ECM to mobilise the engine.
- If the response is incorrect, the Instrument Cluster will request the ECM to immobilise the engine

This request is made via the High Speed CAN Communication Bus.

Immobilised State

- If a faulty or invalid key is used to start:
- The Instrument Cluster does not respond to the ECM, as it cannot validate the transponder code.
- If the code does not match, the engine is immobilised by the ECM.
- The Anti Theft Lamp remains ON.

Ignition Key Training

Training new Ignition Key Transponders can only be done with the Ford IDS scan tool and factory mainframe computer access.

- The Scan Tool obtains an Outcode from the Instrument Cluster
- The Outcode is entered into the Ford mainframe to obtain an Incode
- The Incode must be entered into the scan tool within 20 minutes in order to train the keys.

A minimum of 2 and a maximum of 8 Ignition Key Transponders can be trained to the vehicle.

Note!

Module Configuration and training new keys can only be done with the Ford IDS Consult scan tool.

Instrument Cluster

The hybrid type Instrument Cluster operates using both hard wire and Serial Communication.

It contains an LCD Display and Message Centre (If Fitted).

The Instrument Cluster incorporates:

- Instrument Cluster ECU
- Malfunction Indicator Lamp (MIL)
- Glow Plug Indicator Lamp
- PATS Anti Theft Lamp
- Water Separator Lamp
- Alternator Warning Lamp
- Engine Low Oil Pressure Warning Lamp
- Cruise Control Indicator Lamp
- Upshift Lamp.

The Upshift Lamp is a red arrow that flashes at 4500 RPM to warn the driver to upshift to a higher gear.

Instrument Cluster ECM

The Instrument Cluster ECM is located in the Instrument Cluster. It forms a gateway between the High Speed and the Medium Speed CAN Communication Bus.

It receives operational status signals from the:

- Accelerator Pedal Position Sensor
- Cruise Control Brake Pedal Switch
- Cruise Control Clutch Pedal Switch
- PATS Transceiver.

The Instrument Cluster ECM then communicates this information to the ECM via the High Speed CAN Communication Bus.

Intake Air Temperature Sensor

The Intake Air Temperature Sensor is located in the Throttle Body behind the air shut off valve.

The ECM monitors this sensor to determine intake air temperature.

To Test Voltage:

See ECM Pin #A22 and A47.

Low Fuel Level Strategy

If the fuel level in the tank drops to approximately 4 litres, the ECM will initiate rough running to warn the driver.

This should reduce the risk of fuel run out and eliminate the need for bleeding the fuel system.

Main Relay

The Main Relay is located in the Fuse and Relay Box on the left side of the engine compartment.

To Test Voltage:

See ECM Pin #A18, C35, C38 and C39.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp is located in the Instrument Cluster. The Instrument Cluster ECU will activate this Lamp based on ECM requests. It is controlled by the Engine ECM via the High Speed CAN Communication Bus.

Note!

Should the MIL illuminate (continuous or flashing), this indicates a system fault.

Check ECM for the presence of Fault Codes.

Mass Air Flow Sensor

The Mass Air Flow Sensor is located in the air intake duct at the outlet of the air filter housing. It is a hot wire type. The ECM monitors this sensor to determine the quantity and speed of intake air. The ECM also monitors this sensor to control the exhaust gas recirculation process.

To Test Voltage:

See ECM Pin #A23, A40 and C31.

Serial Communication

These vehicles use BUS Communication (Bi-Directional Universal Signal). The Bus consists of a twisted pair wiring to minimise external interference. The protocol used is Controller Area Network (CAN).

This is a high speed Class C network with a low travel time (Latency). Low latency is critical for powertrain control and vehicle dynamics.

Two separate networks are used.

- The High Speed (HS) protocol communicates at a rate of 500 k baud.
- The Medium Speed (MS) protocol communicates at a rate of 125 k baud.

Both networks are used for certain engine management functions. The Bus consists of a twisted pair wiring to minimise external interference. Each module in the CAN Bus is a "node" and sends and receives messages.

The "Terminating Nodes" are inside the ECM, the Instrument Cluster and the Generic Electronic Module (GEM).

The terminating nodes contain 120 ohm resistors across each Bus wire to prevent corruption of signals.

The Instrument Cluster is the gateway between the High Speed and Medium Speed CAN networks.

High Speed CAN Communication Bus

The HS CAN Bus links the:

- ECM
- Instrument Cluster
- Diagnostic Connector
- Electronic Power Steering Module
- ABS / ESP Module.

To Test Voltage:

See ECM Pin #B29 and B30.

Medium Speed CAN Communication Bus

The MS CAN Bus links the:

- Instrument Cluster
- Generic Electronic Module (GEM)
- Diagnostic Connector
- Automatic Climate Control Unit (If Fitted)
- Air Bag Control Module
- Audio System
- Park Aid Module (If Fitted)
- Door Control Modules
- Key Free Module.

Note!

If there is a break or short in the CAN network, some modules will not be able to communicate with each other. If the CAN Bus is shorted together, to power or to ground, then all communication will cease.

Testing High Speed CAN Communication Bus:

The CAN end bus 120 Ohm resistors are located in the ECM and the Instrument Cluster.

To Test Resistance:

Disconnect battery ground terminal, measure across Diagnostic Connector terminals #6 and #14:

Should be 60 Ohms approx.

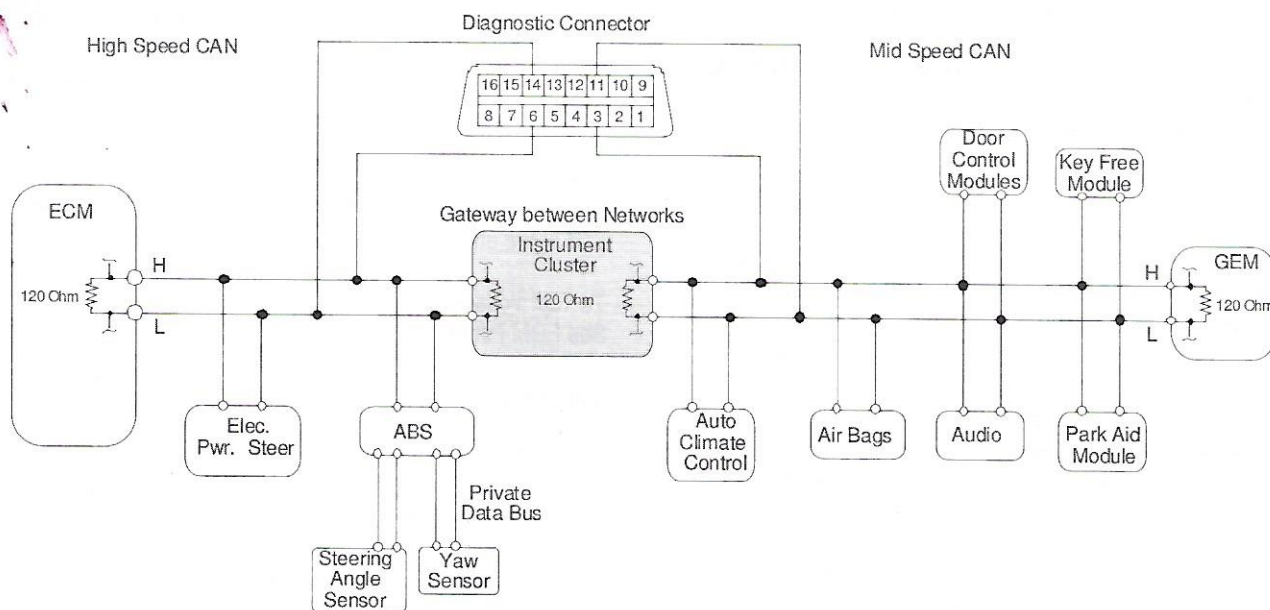
Testing Medium Speed CAN Communication Bus:

The Medium Speed CAN end bus 120 Ohm resistors are located in the Instrument Cluster and the Generic Electronic Module (GEM).

To Test Resistance:

Disconnect battery ground terminal, measure across Diagnostic Connector terminals #3 and #11:

Should be 60 Ohms approx.



Ford Focus 2.0 L Diesel High and Mid Speed CAN Networks

Starter Motor Relay

The Starter Motor Relay is located in the Fuse and Relay Box on the left side of the engine compartment. It is used to control the inhibitor operation of the starter motor.

To Test Voltage:
See ECM Pin #B20.

Throttle Body

The Throttle Body is located at the intake manifold. It contains the:

- Throttle Vacuum Actuator
- Throttle Valve.

The Throttle Valve is normally in the approx. fully open position. The Throttle Valve closes fully for a few seconds when the engine is shut down. When the engine is switched OFF, it cuts off all air supply eliminating engine run on.

Throttle Valve Control Solenoid

The Throttle Valve Control Solenoid is located on the left side of the engine below the alternator. The ECM uses it to operate the Throttle Vacuum Actuator.

To Test Voltage:
See ECM Pin #A2.

Turbocharger System

The Turbocharger System incorporates:

- Variable Vane Turbocharger
- Turbocharger Intercooler
- Turbocharger Boost Control System

Turbocharger

The Variable Vane Turbocharger is located on the right side of the engine. Boost pressure is ECM controlled by changing the angle of the turbine feed vanes.

Turbocharger Intercooler

The Turbocharger Intercooler is located in front of the radiator. The incoming air is compressed by the Turbocharger causing it to become heated.

This air is then cooled by the Intercooler to give greater volumetric efficiency.

Note!

Ensure all turbocharger hose connections are clean and secure.

Turbocharger Boost Control System

The Turbocharger Boost Control System consists of:

- Turbocharger Boost Control Actuator
- Turbocharger Boost Actuator Position Sensor
- Turbocharger Boost Control Solenoid
- Turbocharger Boost Pressure Sensor.

Turbocharger Boost Control Actuator

The Turbocharger Boost Control Actuator is located at the Turbocharger. It is operated by vacuum applied by the Turbocharger Boost Control Solenoid. It varies the angle of the turbine feed vanes.

Turbocharger Boost Actuator Position Sensor

The Turbocharger Boost Actuator Position Sensor is located at the Actuator diaphragm.

The ECM uses this sensor to calculate turbocharger variable vane position.

To Test Voltage:
See ECM Pin #A29, A36 and A37.

Turbocharger Boost Control Solenoid

The Turbocharger Boost Control Solenoid is located at the thermostat housing at the rear of the cylinder head. The ECM applies a duty cycle signal to meter vacuum through the solenoid and operate the Turbocharger Boost Control Actuator.

To Test Voltage:
See ECM Pin #A4.

Turbocharger Boost Pressure Sensor

The Turbocharger Boost Pressure Sensor is located at the Throttle Body. The ECU monitors this sensor for engine load values and Turbocharger boost pressure.

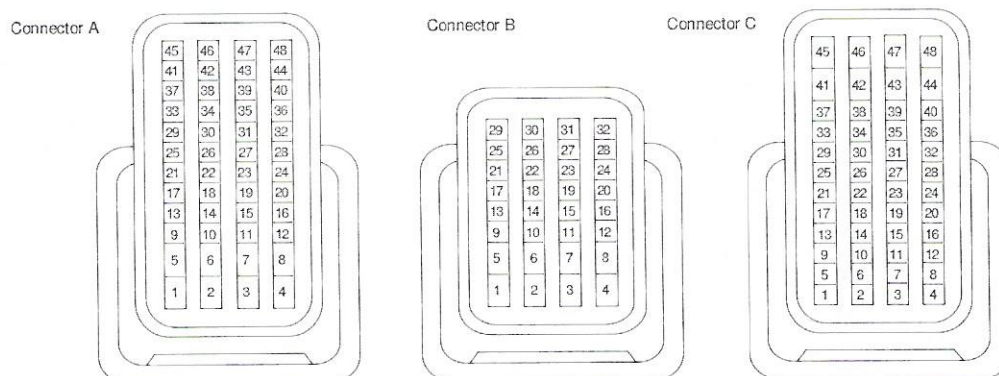
To Test Voltage:
See ECM Pin #C5, C13 and C18.

Vacuum Pump

The Vacuum Pump is located at the left rear corner of the cylinder head. It is driven by the intake camshaft. It provides vacuum for various actuator solenoids.

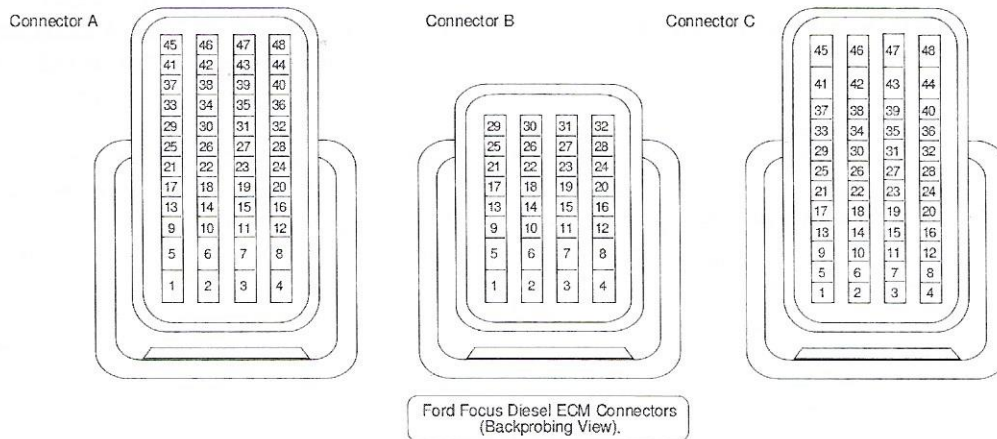
Vehicle Speed Signal (VSS)

Vehicle Speed Signal is obtained from the ABS / ESP Module. It is communicated to the ECM and the Instrument Cluster via the High Speed Can Communication Bus.



Ford Focus Diesel ECM Connectors
(Backprobing View)

ECM Voltage Table



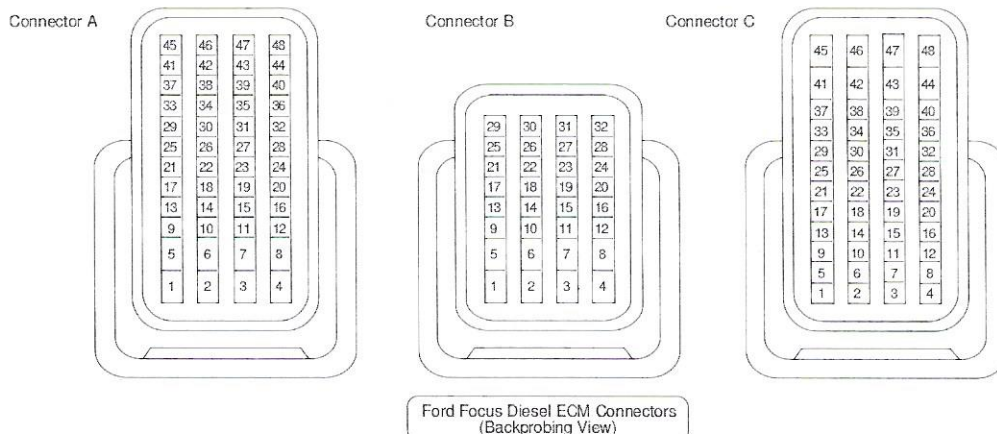
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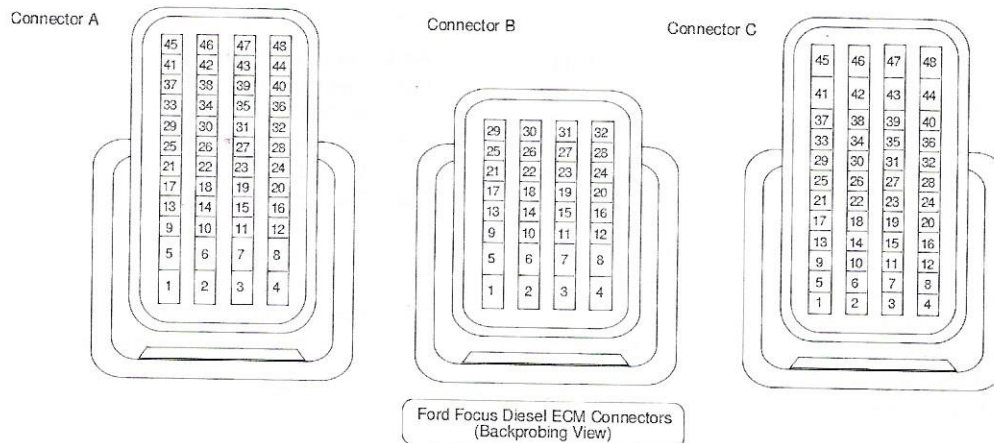
High voltages are used to operate the fuel injectors.
Ensure ignition is OFF before touching or disconnecting injector wiring.

Connector 'A'

Pin #	Circuit and Status	Voltage
A1	Fuel Metering Valve	
	Engine Cranking or Running	Duty Cycle Signal
A2	Throttle Actuator Solenoid	
	Throttle Valve Open	High Volts
	Throttle Valve Closed	Low Volts
A3	EGR Actuator Power +	
	Engine Running	Duty Cycle Signal
A4	Turbocharger Boost Control Solenoid	
	Engine Running	Duty Cycle Signal
A5	Fuel Pressure Solenoid	
	Engine Running	Duty Cycle Signal
A7	EGR Actuator Power -	
	Engine Running	Duty Cycle Signal
A11	ECM Ground	
	All Times	0 Volts
A16	Cooling System Bypass Solenoid (If Fitted)	
	Valve Closed	Battery Volts
	Valve Open	Low Volts
A17	Alternator Monitor	
	No Specifications Available	PWM Signal
A18	Main Relay Control	
	Ignition OFF	Battery Volts
	Ignition ON	Low Volts
A21	Keep Alive Memory Power	
	All Times	Battery Volts
A22	Intake Air Temperature Sensor Ground	
	All Times	0 Volts

Pin #	Circuit and Status	Voltage
A23	Mass Air Flow Sensor Ground	
	All Times	0 Volts
A24	Cooling System Shut Off Solenoid (If Fitted)	
	Valve Closed	Low Volts
	Valve Open	Battery Volts
A29	Turbocharger Boost Actuator Position Sensor Ground	
	All Times	0 Volts
A31	EGR Position Sensor Ground	
	All Times	0 Volts
A32	Glow Plug Control Module Command	
	No Specifications Available	N/A
A33	Glow Plug Control Module Diagnosis	
	No Specifications Available	N/A
A35	EGR Position Sensor Signal	
	Engine Running	
	0% EGR Flow	0.9 Volts Approx.
	100% EGR Flow	4.2 Volts Approx.
A36	Turbocharger Boost Actuator Position Sensor Power Supply	
	Ignition ON	5 Volts
A37	Turbocharger Boost Actuator Position Signal	
	No Specifications Available	N/A
A38	EGR Position Sensor Power Supply	
	Ignition ON	5 Volts
A40	Mass Air Flow Sensor Signal	
	No Specifications Available	N/A
A47	Intake Air Temperature Sensor Signal	
	No Specifications Available	N/A



**Connector 'B'**

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
B1	ECM Ground	0 Volts	B20	Starter Motor Relay	
	All Times			Ignition ON	
B3	Air Conditioner Low Pressure Switch			Relay OFF	Battery Volts
	Ignition ON			Relay ON	Low Volts
	Normal A/C System Pressure	Low Volts	B22	ECM Power Supply	
	Low A/C System Pressure	High Volts		Ignition ON	Battery Volts
	High A/C System Pressure	High Volts	B27	Engine Cooling Fan Module	
B5	ECM Ground	0 Volts		No Specifications Available	N/A
	All Times		B29	Serial Communication (CAN High)	
B10	Accelerator Pedal Position Sensor	N/A		Ignition ON	
	No Specifications Available			Data Idle State	2.5 Volts Approx.
B13	Brake Lamp Switch			During Data Transmission	Serial Data
	Ignition ON		B30	Serial Communication (CAN Low)	
	Brake Pedal Released	0 Volts		Ignition ON	
	Brake Pedal Depressed	Battery Volts		Data Idle State	2.5 Volts Approx.
B17	Air Conditioner Relay			During Data Transmission	Serial Data
	Ignition ON		B32	Alternator Command	
	A/C Compressor Clutch OFF	Battery Volts		No Specifications Available	PWM Signal
	A/C Compressor Clutch ON	Low Volts			
B19	Air Conditioner High Pressure Switch				
	Ignition ON				
	Normal A/C System Pressure	High Volts			
	High A/C System Pressure	Low Volts			

Connector 'C'

Pin #	Circuit and Status	Voltage	Pin #	Circuit and Status	Voltage
C2	Engine Coolant Temperature Sensor		C19	Camshaft Position Sensor Power Supply	
	Ignition ON			Ignition ON	5 Volts
	Coolant Temperature @ 60°C	1.33 Volts	C21	Crankshaft Position Sensor Ground	
	Coolant Temperature @ 80°C	0.78 Volts		All Times	0 Volts
	Coolant Temperature @ 100°C	0.46 Volts	C23	Engine Oil Pressure Switch	
C3	Fuel Temperature Sensor			Ignition ON	
	No Specifications Available	N/A		Low Oil Pressure	Low Volts
C4	Fuel Rail Pressure Sensor Power Supply			Normal Oil Pressure	High Volts
	Ignition ON	5 Volts	C24	Crankshaft Position Sensor Power Supply	
C5	Turbocharger Boost Sensor			Ignition ON	5 Volts
	No Specifications Available	N/A	C25	Engine Coolant Temperature Sensor Ground	
C6	Fuel Rail Pressure Sensor			All Times	0 Volts
	No Specifications Available	N/A	C30	Water In Fuel Sensor	
C7	Fuel Rail Pressure Sensor Ground			No Specifications Available	N/A
	All Times	0 Volts	C31	Mass Air Flow Sensor Ground	
C8	Crankshaft Position Sensor			All Times	0 Volts
	Engine Cranking or Running	Voltage Pulse	C32	ECM Ground	
C9	Camshaft Position Sensor			All Times	0 Volts
	Engine Cranking or Running	Voltage Pulse	C33	Fuel Temperature Sensor Ground	
C11	ATCP Module (If Fitted)			All Times	0 Volts
	BUS Line Positive	Data Stream	C34	ATCP Module (If Fitted)	
C13	Turbocharger Boost Sensor Ground			BUS Line Negative	Data Stream
	All Times	0 Volts	C35	ECM Power Supply	
C16	Camshaft Position Sensor Ground			Ignition ON	Battery Volts
	All Times	0 Volts	C36	ECM Ground	
C18	Turbocharger Boost Sensor Power Supply			All Times	0 Volts
	Ignition ON	5 Volts			

Connector 'C' (cont.)

Pin # Circuit and Status

C38 ECM Power Supply

Ignition ON

C39 ECM Power Supply

Ignition ON

C40 ECM Ground

All Times

C41 Fuel Injector #2 Ground

No Specifications Available

C42 Fuel Injector #3 Ground

No Specifications Available

C43 Fuel Injector #1 Ground

No Specifications Available

Voltage

Battery Volts

Battery Volts

0 Volts

N/A

N/A

N/A

Pin # Circuit and Status

C44 Fuel Injector #4 Ground

No Specifications Available

C45 Fuel Injector #4 Power

No Specifications Available

C46 Fuel Injector #2 Power

No Specifications Available

C47 Fuel Injector #1 Power

No Specifications Available

C48 Fuel Injector #3 Power

No Specifications Available

Voltage

N/A

N/A

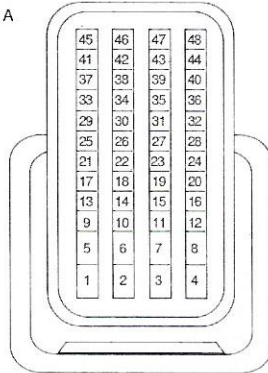
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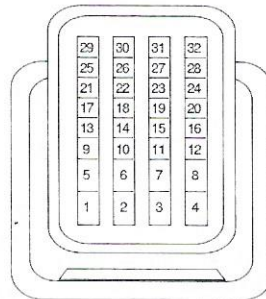
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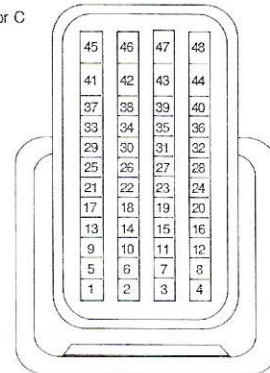
Connector A



Connector B



Connector C

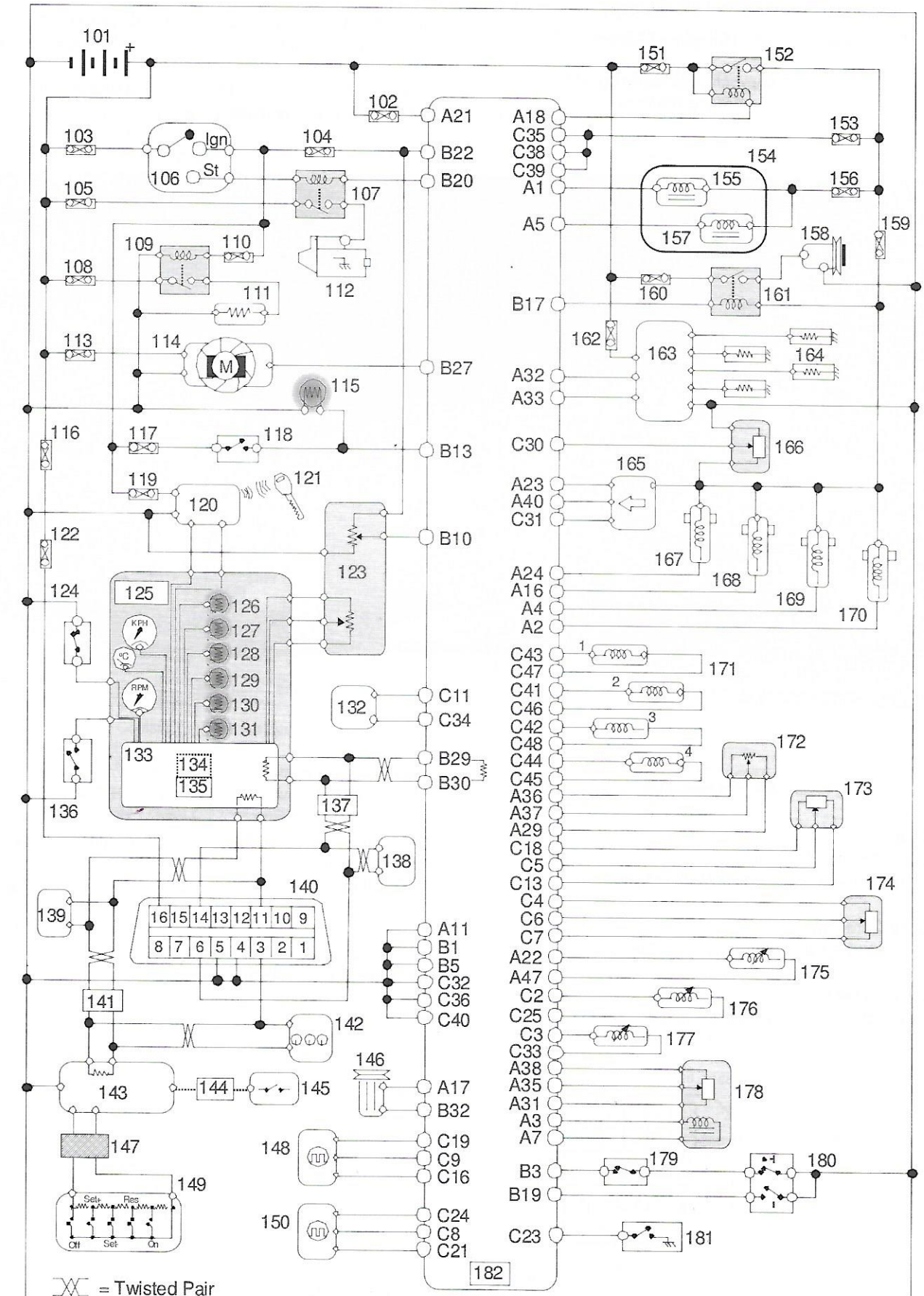


Ford Focus Diesel ECM Connectors
(Backprobing View)

Key to Wiring Diagram (next page)

- | | | |
|---|--|--|
| 101. Battery | 129. Alternator Warning Lamp | 156. Fuse 34 – 10 Amp |
| 102. Fuse 30 – 3 Amp | 130. Low Oil Pressure Warning Lamp | 157. Fuel Pressure Control Valve |
| 103. Fuse 11 – 20 Amp | 131. Upshift Warning Lamp | 158. Air Conditioner Compressor |
| 104. Fuse 75 – 10 Amp | 132. ATCP Module (If Fitted) | 159. Fuse 35 – 10 Amp |
| 105. Fuse 13 – 20 Amp | 133. Instrument Cluster ECM | 160. Fuse 27 – 10 Amp |
| 106. Ignition Switch | 134. Message Centre Display (If Fitted) | 161. Air Conditioner Cut Out Relay |
| 107. Starter Motor Relay | 135. Instrument Panel LCD Display | 162. Fuse 6 – 60 Amp |
| 108. Fuse 24 – 15 Amp | 136. Cruise Control Clutch Pedal Switch | 163. Glow Control Module |
| 109. Fuel Heater Relay | 137. High Speed CAN Communication Bus | 164. Glow Plugs |
| 110. Fuse 25 – 10 Amp | 138. High Speed Can Modules | 165. Mass Air Flow Sensor |
| 111. Fuel Heater Element (Part of Fuel Filter Assembly) | 139. Medium Speed CAN Modules | 166. Fuel - Water Warning Lamp Switch |
| 112. Starter Motor | 140. Diagnostic Connector | 167. Cooling System Shutoff Solenoid Valve (If Fitted) |
| 113. Fuse 1 – 60 Amp | 141. Medium Speed CAN Communication Bus | 168. Cooling System Bypass Solenoid Valve (If Fitted) |
| 114. Engine Cooling Fan Module and Fan Motor | 142. Air Conditioner Control Module (Auto A/C) | 169. Turbocharger Boost Control Solenoid |
| 115. Brake Lamps Circuit | 143. Generic Electronic Control Module (GEM) | 170. Throttle Valve Control Solenoid |
| 116. Fuse 3 – 60 Amp | 144. Manual Air Conditioner Circuit | 171. Fuel Injectors |
| 117. Fuse 74 – 15 Amp | 145. Air Conditioner Control Module (Manual A/C) | 172. Turbocharger Boost Actuator Position Sensor |
| 118. Brake Lamp Switch | 146. Alternator | 173. Turbocharger Boost Pressure Sensor |
| 119. Fuse 67 – 10 Amp | 147. Clockspring | 174. Fuel Rail Pressure Sensor |
| 120. PATS Ignition Lock Transceiver (Immobilisation) | 148. Camshaft Position Sensor | 175. Intake Air Temperature Sensor |
| 121. PATS Ignition Key Transceiver (Immobilisation) | 149. Cruise Control Steering Wheel Switches | 176. Engine Coolant Temperature Sensor |
| 122. Fuse 44 – 10 Amp | 150. Crankshaft Position Sensor | 177. Fuel Temperature Sensor |
| 123. Accelerator Pedal Position Sensor | 151. Fuse 9 – 20 Amp | 178. Exhaust Gas Recirculation (EGR) Valve Assembly |
| 124. Cruise Control Brake Pedal Switch | 152. Main Relay | 179. Air Conditioner Low Pressure Switch |
| 125. Instrument Cluster | 153. Fuse 36 – 10 Amp | 180. Air Conditioner Dual High Pressure Switch |
| 126. Malfunction Indicator Lamp | 154. Fuel Injector Pump | 181. Engine Oil Low Pressure Switch |
| 127. Glow Plug Lamp | 155. Fuel Metering Valve | 182. Electronic Control Module |
| 128. PATS Anti Theft Lamp | | |

Wiring Diagram



Ford Focus 2.0L Common Rail Diesel Engine Wiring Diagram

Manufacturer: FORD

Application: Ranger 2006-07
2.5L Diesel WL-C Engine
3.0L Diesel WE-C Engine

Subject: Engine Management System

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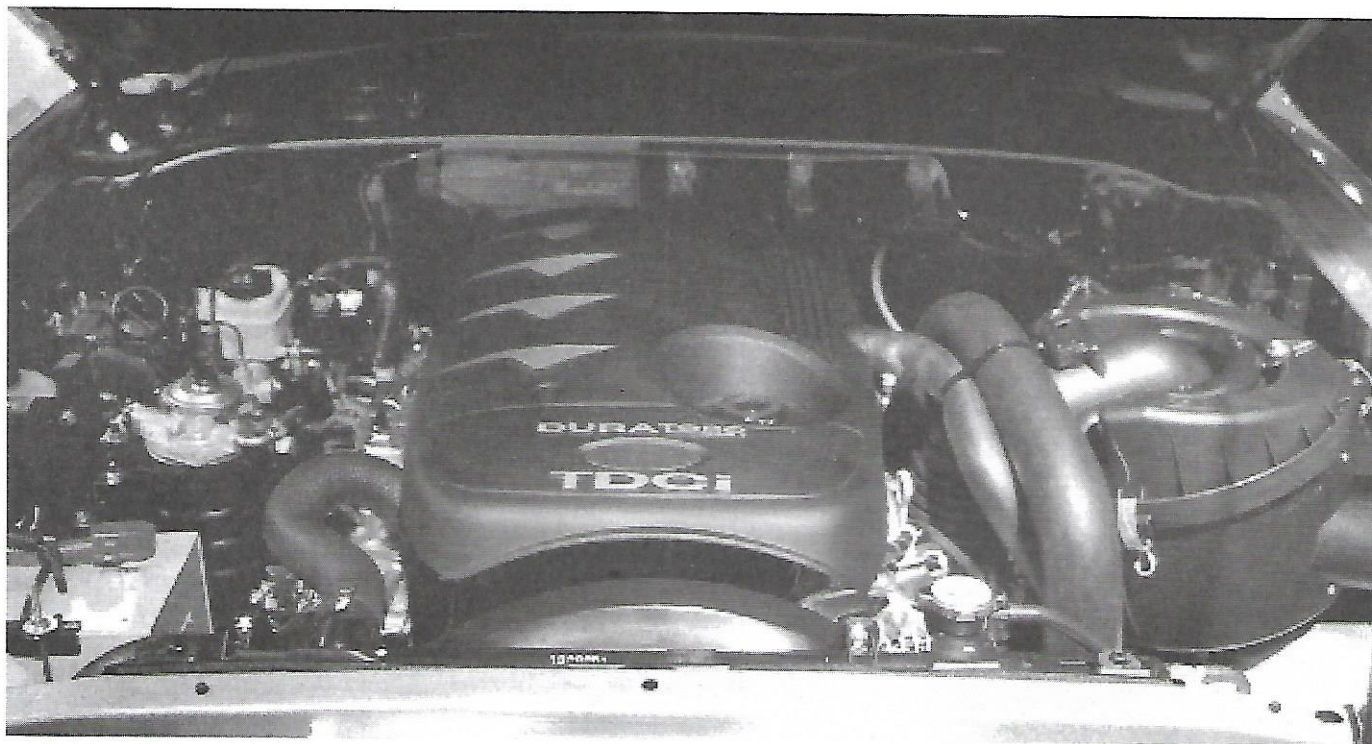
Overview

These vehicles are fitted with the 2.5L WL-C and 3.0L WE-C engines.

They are 4 cylinder DOHC turbocharged aftercooled common rail diesel engines.

The system controls fuel injection, glow and variable turbo boost. Some models are fitted with PCM controlled Remote Free Wheel for the front axle.

Exhaust gases are cleaned using an EGR system and an Oxidation Catalytic Converter.



ECM

The ECM is located behind the right kickpanel.

Fault Codes

The Fault Codes are OBDII type.

They can be accessed using a compatible scan tool.

Fault Code Extraction

Fault Codes can be extracted using a compatible scan tool.

Fault Code Erasure

Fault Codes can be erased using a compatible scan tool.

Diagnostic Connectors

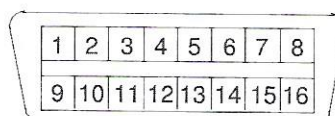
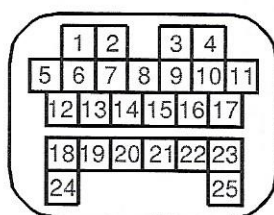
These vehicles use the Mazda 25 pin and an OBDII type Diagnostic Connector.

The Mazda 25 Pin connector is located at the left rear of the engine compartment.

The OBDII type Diagnostic Connector is located under the driver dash.

To Test Voltage:

See ECM Pin #A71, A95, B26 and B31.



Ford / Mazda Diagnostic Connectors

Fault Code Identification

Code #	Fault	Code #	Fault
P0016	Crankshaft - Camshaft Position Sensor Correlation	P0228	Idle Switch Circuit High Input
P0045	Variable Boost Control Solenoid Open Circuit	P0300	Random Misfire Detected
P0046	Variable Boost Control Solenoid Range / Performance	P0301	Cylinder #1 Misfire Detected
P0047	Variable Boost Control Solenoid Low Input	P0302	Cylinder #2 Misfire Detected
P0048	Variable Boost Control Solenoid High Input	P0303	Cylinder #3 Misfire Detected
P0088	Fuel Pressure System Too High	P0304	Cylinder #4 Misfire Detected
P0093	Fuel System Leak Detection	P0335	Crankshaft Position Sensor Circuit malfunction
P0097	Intake Air Temperature Sensor #2 Circuit Low Input	P0340	Camshaft Position Sensor Circuit malfunction
P0098	Intake Air Temperature Sensor #2 Circuit High Input	P0380	Glow Plug Relay Circuit Malfunction
P0101	Mass Air Flow Meter Range / Performance	P0401	Exhaust Gas Recirculation Flow Insufficient Detected
P0102	Mass Air Flow Meter Circuit Low Input	P0402	Exhaust Gas Recirculation Flow Excessive Detected
P0103	Mass Air Flow Meter Circuit High Input	P0403	Exhaust Gas Recirculation Solenoid Circuit Malfunction
P0106	Boost Sensor Range / Performance	P0404	Exhaust Gas Recirculation Valve Stuck
P0107	Boost Sensor Circuit Low Input	P0405	Exhaust Gas Recirculation Valve Position Sensor Low Input
P0108	Boost Sensor Circuit High Input	P0406	Exhaust Gas Recirculation Valve Position Sensor High Input
P0111	Intake Air Temperature Sensor #1 Range / Performance	P0489	Exhaust Gas Recirculation Solenoid Control Circuit Low Input
P0112	Intake Air Temperature Sensor #1 Circuit Low Input	P0490	Exhaust Gas Recirculation Solenoid Control Circuit High Input
P0113	Intake Air Temperature Sensor #1 Circuit High Input	P0500	Vehicle Speed Sensor Circuit Malfunction
P0116	Engine Coolant Temperature Sensor Range / Performance	P0562	Battery Voltage Low Input
P0117	Engine Coolant Temperature Sensor Circuit Low Input	P0563	Battery Voltage High Input
P0118	Engine Coolant Temperature Sensor Circuit High Input	P0602	ECM Programming Error
P0122	Accelerator Pedal Position Sensor #1 Circuit Low Input	P0603	ECM Malfunction
P0123	Accelerator Pedal Position Sensor #1 Circuit High Input	P0607	ECM Performance
P0182	Fuel Temperature Sensor Circuit Low Input	P0610	ECM Vehicle Options Error
P0183	Fuel Temperature Sensor Circuit High Input	P0627	Fuel Metering Valve Control Circuit Open
P0191	Fuel Pressure Sensor Range / Performance	P0628	Fuel Metering Valve Control Circuit Low Input
P0192	Fuel Pressure Sensor Circuit Low Input	P0629	Fuel Metering Valve Control Circuit High Input
P0193	Fuel Pressure Sensor Circuit Low Input	P0642	Fuel Pressure Sensor and Boost Sensor 5 Volt Circuit Low Input
P0201	Fuel Injector #1 Circuit Open / Short	P0643	Fuel Pressure Sensor and Boost Sensor 5 Volt Circuit High Input
P0202	Fuel Injector #2 Circuit Open / Short	P0652	Camshaft and Accelerator Pedal Position Sensors 5 Volt Circuit Low Input
P0203	Fuel Injector #3 Circuit Open / Short	P0653	Camshaft and Accelerator Pedal Position Sensors 5 Volt Circuit High Input
P0204	Fuel Injector #4 Circuit Open / Short	P0660	Intake Shutter Solenoid Half Control Circuit Open
P0222	Accelerator Pedal Position Sensor #2 Circuit Low Input	P0661	Intake Shutter Solenoid Half Control Circuit Low Input
P0223	Accelerator Pedal Position Sensor #2 Circuit High Input	P0662	Intake Shutter Solenoid Half Control Circuit High Input
P0227	Idle Switch Circuit Low Input	P0663	Intake Shutter Solenoid Full Control Circuit Open

Code #	Fault	Code #	Fault
P0664	Intake Shutter Solenoid Full Control Circuit Low Input	P1878	Remote Free Wheel Free Solenoid Circuit Failure
P0665	Intake Shutter Solenoid Full Control Circuit High Input	P1879	Remote Free Wheel Free Solenoid Open Circuit
P0685	Main Relay Control Circuit Open	P1880	Remote Free Wheel Free Solenoid Circuit Short to Battery
P0698	Exhaust Gas Recirculation Valve Position Sensor 5 Volt Circuit Low Input	P1885	Remote Free Wheel Free Solenoid Circuit Short to Ground
P0699	Exhaust Gas Recirculation Valve Position Sensor 5 Volt Circuit High Input	P2008	Variable Swirl Control Solenoid Circuit Open
P1196	Key Off Voltage High Input	P2009	Variable Swirl Control Solenoid Circuit Low Input
P1259	Immobiliser to ECM Signal Error	P2010	Variable Swirl Control Solenoid Circuit High Input
P1260	Theft Detected Vehicle Immobiliser	P2135	Accelerator Pedal Position Sensor 1 and 2 Voltage Correlation Problem
P1391	Glow Plug Control Circuit Low Input	P2136	Accelerator Pedal Position Sensor 1 and 2 Idle Switch Voltage Correlation Problem
P1392	Glow Plug Control Circuit High Input	P2143	Exhaust Gas Recirculation Solenoid Control Circuit Open
P1528	Exhaust Shutter Solenoid Circuit Problem	P2144	Exhaust Gas Recirculation Solenoid Control Circuit Low Input
P1602	Immobiliser to ECM Communication Error	P2145	Exhaust Gas Recirculation Solenoid Control Circuit High Input
P1603	ID Number Unregistered	P2146	Fuel Injector #1 and 4 Power Supply Circuit Malfunction
P1604	Code Word Unregistered	P2147	Fuel Injector #1 and 4 Power Supply Circuit Low Input
P1621	Immobiliser Code Word Does Not Match	P2148	Fuel Injector #1 and 4 Power Supply Circuit High Input
P1622	Immobiliser ID Does Not Match	P2149	Fuel Injector #2 and 3 Power Supply Circuit Malfunction
P1623	Immobiliser Code Word /ID Number Write Failure	P2150	Fuel Injector #2 and 3 Power Supply Circuit Low Input
P1624	Anti-theft System	P2151	Fuel Injector #2 and 3 Power Supply Circuit High Input
P1675	Injection Quantity Adjustment Value Writing Error	P2227	Barometric Air Pressure Sensor Circuit Range / Performance
P1676	Injection Quantity Adjustment Value Checksum Error	P2228	Barometric Air Pressure Sensor Circuit Low Input
P1812	Remote Free Wheel Lock Solenoid Circuit Failure	P2229	Barometric Air Pressure Sensor Circuit High Input
P1813	Remote Free Wheel Lock Solenoid Open Circuit	P2263	Air Charging System Performance Malfunction
P1814	Remote Free Wheel Lock Solenoid Circuit Short to Battery	P2530	ECM (Engine Switch Circuit) Malfunction
P1815	Remote Free Wheel Lock Solenoid Circuit Short to Ground		

4x4 Indicator Lamp (RFW)

The 4x4 Indicator Lamp is located in the instrument panel. It will illuminate when four wheel drive is selected.

To Test Voltage:
See ECM Pin #B32.

4x4 Indicator Switch (RFW)

The 4x4 Indicator Switch is located at the transfer case. The ECM monitors this switch to determine when four wheel drive is selected.

To Test Voltage:
See ECM Pin #A37.

Accelerator Pedal Position Sensor

The dual potentiometer type Accelerator Pedal Position Sensor is located at the accelerator pedal. The ECM monitors this sensor to determine driver demand. It compares the signals from the main and monitor circuits to determine if a fault exists.

To Test Voltage:
See ECM Pin #B9, B12, B13 and B22.

Air Conditioner Refrigerant Low Pressure Switch

The Air Conditioner Refrigerant Low Pressure Switch is located in the air conditioner pressure lines. If the A/C refrigerant pressure is low, it will cut operation of the A/C compressor.

To Test Voltage:
See ECM Pin #A28.

Air Conditioner Relay

The Air Conditioner Relay is located at the rear of the right strut tower. The ECM actuates this relay to control operation of the air conditioner compressor.

To Test Voltage:
See ECM Pin #A28

Barometric Air Pressure Sensor

The Barometric Air Pressure Sensor is incorporated within the ECM.

Boost Pressure Control Operation

The ECM actuates the Variable Boost Control Solenoid through a duty cycle.

When more boost is required, the ECM increases the duty cycle (closes the turbo guide blades).

When less boost is required, the ECM decreases the duty cycle (opens the turbo guide blades).

Boost Pressure Sensor

The Boost Pressure Sensor (piezo electric element) is located at the right centre of the engine. It incorporates Intake Air Temperature Sensor 1. The ECM monitors this sensor to determine the turbocharger boost pressure.

To Test Voltage:

See ECM Pin #A11, A33, A41 and A89.

Brake Lamp Switch

The Brake Lamp Switch is located at the brake pedal. The ECM monitors this switch to determine when the brakes have been applied.

To Test Voltage:

See ECM Pin #B38.

Camshaft Position Sensor

The Camshaft Position (hall effect) Sensor is located at the right front of the cylinder head. The ECM monitors this sensor to determine the position of the camshaft. The pulse wheel installed on the camshaft has a single projection. This sensor will produce a single 26° pulse per revolution of the camshaft.

To Test Voltage:

See ECM Pin #A14, A29 and A60.

Clutch Pedal Position Switch

The Clutch Pedal Position Switch is located at the top of the clutch pedal. The ECM monitors this switch to determine the position of the clutch pedal.

When the clutch pedal is depressed, the contact points are closed.

To Test Voltage:

See ECM Pin #B28.

Crankshaft Position Sensor

The Crankshaft Position (magnetic pickup) Sensor is located on the clutch housing. The ECM monitors this sensor crankshaft speed and position. The pulse wheel installed on the dual mass flywheel has 58 projections 6° apart.

To Test Voltage:

See ECM Pin #A92, A93 and A94.

Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor (thermistor) is located at the right centre of the engine. The ECM monitors this sensor to determine the temperature of the coolant.

To Test Voltage:

See ECM Pin #A56 and A67.

Exhaust Gas Recirculation Control Solenoid

The Exhaust Gas Recirculation Control Solenoid is located at the right centre of the engine block. The ECM actuates this solenoid to control operation of the exhaust gas recirculation.

To Test Voltage:

See ECM Pin #A77.

To Test Resistance:

Disconnect connector and measure between terminals:

Temperature	Resistance
20°C	2.1 to 2.9 k Ohms
50°C	0.68 to 1.0 k Ohms
90°C	0.236 to 0.260 k Ohms

Exhaust Gas Recirculation Cooler

The Exhaust Gas Recirculation Cooler (heat exchanger) is located at the top left of the engine. It cools the exhaust gas prior to the Exhaust Gas Recirculation Valve.

Exhaust Gas Recirculation Operation

To increase the EGR amount, the ECM increases the duty cycle to the EGR Solenoid (increases vacuum to the EGR Valve).

To decrease the EGR amount, the ECM increases the duty cycle to the EGR Control Solenoid (decreases vacuum to the EGR Valve).

Note!

During exhaust gas recirculation operation at low engine speeds, the ECM partially closes the Intake Shutter Valve.

This creates a vacuum in the intake manifold to draw in the exhaust gas for recirculation.

Exhaust Gas Recirculation Solenoid

The Exhaust Gas Recirculation Solenoid is located on top of the vacuum chamber behind the air filter. It is the solenoid closest to the engine.

To Test Voltage:

See ECM Pin #A76.

Exhaust Gas Recirculation Valve

The Exhaust Gas Recirculation Valve is located at the right rear of the engine in the intake manifold.

Exhaust Gas Recirculation Valve Position Sensor

The Exhaust Gas Recirculation Valve Position Sensor is located on top of the Exhaust Gas Recirculation Valve. The ECM monitors this sensor to determine the actual position of the Exhaust Gas Recirculation Valve.

To Test Voltage:

See ECM Pin #A6, A10 and A16.

Fuel Filter

The Fuel Filter is located at the right strut tower. It incorporates the sedimenter switch.

Fuel Metering Valve

The Fuel Metering Valve is located at the rear of the Fuel Pump. The ECM actuates this valve to control the fuel pressure.

To Test Voltage:

See ECM Pin #A79.

Fuel Injectors

The common rail Fuel Injectors are located in the top of the cylinder head. The Fuel Injector Calibration Bar Code must be input into a new ECM.

The ECM controls both fuel injection amount and timing.

Fuel is injected multiple times including multiple auxiliary injections prior to the main injection.

The multiple injections help to smooth the fuel combustion process. This reduces noise and vibration levels as well as the amount of NOx in the exhaust.

The Injector voltage is in the 43 to 53 Volts range.

To Test Voltage:

See ECM Pin #A1, A2, A25, A26, A49, A50, A73 and A74.

Do NOT Measure.

Fuel Pressure

The fuel pressure is controlled by the Fuel Pressure Limiter around 160 MPa (23,206 psi).

The ECM monitors the fuel pressure through the Fuel Pressure Sensor at the end of the common rail.

It commands the Fuel Metering Valve at the Fuel Pump to control fuel flow to maintain the pressure.

Fuel Pressure Limiter

The Fuel Pressure Limiter is located at the rear of the common rail. It maintains the Fuel Pressure and returns any residual fuel to the tank.

Fuel Pressure Sensor

The Fuel Pressure Sensor (piezo electric element) is located at the front end of the common rail. The ECM monitors this sensor to determine the fuel pressure.

To Test Voltage:

See ECM Pin #A9, A40 and A91.

Fuel Pump

The Fuel Pump is located at the right front of the engine at the rear of the timing case. It is mechanically driven from the timing gears. It incorporates the Fuel Temperature Sensor and Fuel Metering Valve.

Fuel Temperature Sensor

The Fuel Temperature Sensor is located at the rear of the Fuel Pump. The ECM monitors this sensor to determine the temperature of the fuel.

To Test Voltage:

See ECM Pin #A15 and A70.

To Test Resistance:

Disconnect connector and measure between terminals:

Temperature	Resistance
20°C	2.3 to 2.6 k Ohms
80°C	0.28 to 0.34 k Ohms

Fuse Locations

The following fuses are located in the main fuse box in the engine compartment:

Fuse Btn1 - 60 Amp

Fuse Btn2 - 60 Amp

Fuse Glow - 60 Amp

Fuse Ig Key 1 - 40 Amp

Fuse Ig Key 2 - 60 Amp

Fuse Inj/Flp - 20 Amp

Fuse Main - 80 Amp

The following fuses are located in fuse block F:

Fuse Stop - 15 Amp

Fuse Engine - 15 Amp

Fuse A/C2 - 10 Amp

Glow Plug Indicator Lamp

The Glow Plug Indicator Lamp is located in the instrument panel.

To Test Voltage:

See ECM Pin #B33.

Glow Plug Operation

The ECM controls Glow Plug operation as follows:

- During preheating timer operation.
- During engine cranking.
- While outer glow is operating.

Glow Plug Preheating Timer

The timer operates for several seconds (dependant on coolant temperature) after ignition on.

The higher the temperature, the shorter the time period.

Glow Plug Continuation Timer

The ECM continues to operate the Glow Plugs after the engine has started.

With coolant temperature <32°C, up to a maximum of 120 seconds.

When coolant temperature reaches 32°C, the Glow Plug Continuation Timer is cancelled.

Glow Plug Relay

The Glow Plug Relay is located in front of the Fuel Filter in front of the right strut tower. The ECM actuates this relay to control operation of the Glow Plugs.

To Test Voltage:

See ECM Pin #A82.

Glow Plugs

The stainless steel Glow Plugs are located in the top of the cylinder head. They are ECM controlled through the Glow Plug Relay. The ECM actuates the Glow Plugs to heat the air in the combustion chambers. This improves cold starting.

To Test Voltage:

See ECM Pin #B27.

Idle Speed (Base)

Idle Speed is ECM controlled and is NOT adjustable.

Target Idle Speed

No Load - 720 RPM.

A/C ON - 750 RPM.

Warming Up - 720 to 1000 RPM.

Idle Switch

The Idle Switch is located at the accelerator pedal. The ECM monitors this switch to determine when the accelerator pedal is at idle position. It compares this signal with the idle position from the Accelerator Pedal Position Sensor.

To Test Voltage:
See ECM Pin #A61.

Intake Air Temperature Sensor 1

The Intake Air Temperature Sensor 1 is incorporated with the Boost Sensor. The ECM monitors this sensor to determine the temperature of the charge air.

To Test Voltage:
See ECM Pin #A11 and A41.

To Test Resistance:
Disconnect connector and measure between terminals:

Temperature	Resistance
20°C	2.1 to 2.9 k Ohms
50°C	0.68 to 1.0 k Ohms
90°C	0.236 to 0.260 k Ohms

Intake Air Temperature Sensor 2

The Intake Air Temperature Sensor 2 is incorporated with the Mass Air Flow Meter. The ECM monitors this sensor to determine the ambient air temperature.

To Test Voltage:
See ECM Pin #A54 and A88.

To Test Resistance:
Disconnect connector and measure between terminals:

Temperature	Resistance
20°C	2.1 to 2.9 k Ohms
50°C	0.68 to 1.0 k Ohms
90°C	0.236 to 0.260 k Ohms

Intake Shutter Solenoid Full

The Intake Shutter Solenoid Full is located at the right strut tower behind the Intake Shutter Valve. It is to the front of the Intake Shutter Solenoid Half. The ECM actuates this solenoid to prevent engine vibrations during shut down.

To Test Voltage:
See ECM Pin #A55.

Intake Shutter Solenoid Half

The Intake Shutter Solenoid Half is located at the right strut tower behind the Intake Shutter Valve. It is to the rear of the Intake Shutter Solenoid Full. The ECM actuates this solenoid to create manifold vacuum for EGR control.

To Test Voltage:
See ECM Pin #A52.

Intake Shutter Valve

The Intake Shutter Valve is located at the front of the intake manifold. The ECM actuates this valve through the Intake Shutter Solenoids.

Main Relay

The Main Relay is located in the right kickpanel.

To Test Voltage:
See ECM Pin #B19.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp is located in the instrument panel. Should the ECM detect a malfunction, this lamp will be illuminated.

To Test Voltage:
See ECM Pin #B56.

Mass Air Flow Meter

The hot wire type Mass Air Flow Meter is located in the air filter. It incorporates Intake Air Temperature Sensor 2. The ECM monitors this sensor to determine the quantity of incoming air.

To Test Voltage:
See ECM Pin #A54, A69, A88 and A90.

Neutral Switch

The Neutral Switch is located at the transmission lid. The ECM monitors this switch to determine when the main transmission is in neutral gear.

To Test Voltage:
See ECM Pin #B40.

Oxidation Catalytic Converter

The Oxidation Catalytic Converter is installed in the exhaust

Remote Free Wheel Indicator Lamp

The Remote Free Wheel Indicator Lamp is located in the instrument panel. The ECM will illuminate this lamp when the Remote Free Wheel is locked.

To Test Voltage:
See ECM Pin #B44.

Remote Free Wheel Free Solenoid

The Remote Free Wheel Free Solenoid is located at the lower left side of the engine compartment. The ECM actuates this solenoid to unlock the Remote Free Wheel at the front differential.

To Test Voltage:
See ECM Pin #B54.

Remote Free Wheel Lock Solenoid

The Remote Free Wheel Lock Solenoid is located at the lower left side of the engine compartment. The ECM actuates this solenoid to lock the Remote Free Wheel at the front differential.

To Test Voltage:
See ECM Pin #B53.

Remote Free Wheel Main Switch

The Remote Free Wheel Main Switch is located in the dash. The ECM monitors this switch to determine driver demand to free the Remote Free Wheel.

To Test Voltage:
See ECM Pin #B58.

Remote Free Wheel Switch

The Remote Free Wheel Switch is located on the Remote Free Wheel unit at the front axle. When the Remote Free Wheel is locked this switch closes.

To Test Voltage:
See ECM Pin #B85.

Remote Free Wheel System

The Remote Free Wheel System is ECM controlled. It incorporates a dog clutch at the left side of the front differential controlled by the RFW actuator. This is actuated by vacuum to shift the dog clutch into and out of mesh as required for free wheeling.

The Remote Free Wheel Lock Solenoid applies vacuum to slide the dog clutch into the lock position.

The Remote Free Wheel Free Solenoid applies vacuum to slide the dog clutch into the free position.

When the vehicle is stopped and the shift lever moved from 2H to 4H, the RFW unit is automatically locked. The 4x4 and RFW Indicator Lamps are illuminated.

Note!

Do not attempt to lock the RFW while the vehicle is in motion. In RFW free condition, the movement of the right front wheel is transferred through the planetary gears (the crownwheel, pinion and front driveshaft remain stationary) and the sleeve will be turning in the opposite direction to the shaft.

When the shift lever moved from 4H to 2H, 4 wheel drive is disconnected but the RFW remains locked.

The 4x4 Indicator Lamp is extinguished, and the RFW Indicator Lamp remains illuminated. In this state, the shift lever can be shifted from 2H to 4H and back on the run.

With the shift lever in 2H and the RFW Main Switch is depressed once, the RFW unit is unlocked.

The 4x4 and RFW Indicator Lamps are extinguished.

Note!

The transfer case and front differential oils may overheat if the vehicle is operated with the Remote Free Wheel System locked at high speed. At speeds >100 kph with the RFW locked, the RFW Indicator Lamp will flash at 0.3 second intervals. When speed falls below 96 kph, the lamp will cease to flash and remain illuminated.

Transfer Neutral Switch (RFW)

The Transfer Neutral Switch is located at the transfer case.

The ECM monitors this switch to determine when the transfer case is in the neutral position. When the shift lever is in the neutral position, the contact points are closed.

To Test Voltage:
See ECM Pin #A35.

Turbocharger

A variable boost (variable geometry) turbocharger is used. Optimum boost is obtained by changing the opening angle of the guide blades and changing the exhaust pressure acting on the impeller.

When the guide blades are closed, the passages leading the exhaust gas to the turbine narrow and the exhaust gas flow rate (and boost) increases.

When the guide blades are opened, the passages leading the exhaust gas to the turbine widen and the exhaust gas flow rate (and boost) decreases.

Vacuum Pump

The Vacuum Pump is located at the right front of the engine in the front of the timing case. It supplies vacuum to the Vacuum Chamber and various solenoids.

Variable Boost Control Solenoid

The Variable Boost Control Solenoid is located on top of the vacuum chamber behind the air filter. It is the solenoid furthest from the engine.

The ECM actuates this solenoid to control operation of the variable turbocharger guide blades.

To Test Voltage:
See ECM Pin #A78.

Variable Swirl Control Solenoid

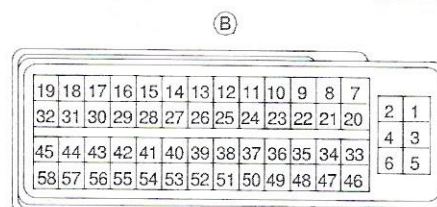
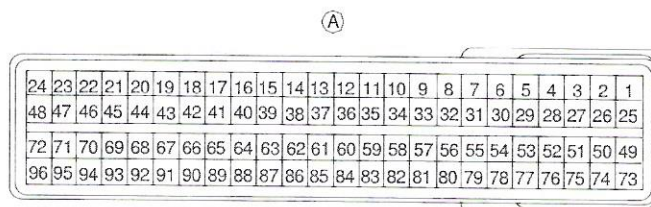
The ECM actuates this solenoid (if fitted) to control operation of the variable intake swirl.

To Test Voltage:
See ECM Pin #A81.

Vehicle Speed Sensor

The Vehicle Speed Sensor is located in the instrument panel. The ECM monitors this sensor for vehicle speed.

To Test Voltage:
See ECM Pin #A84



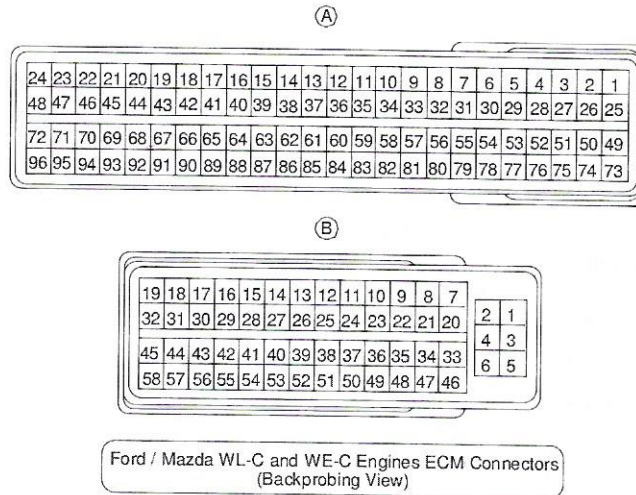
Ford / Mazda WL-C and WE-C Engines ECM Connectors
(Backprobing View)

ECM Voltage Table

Connector 'A'

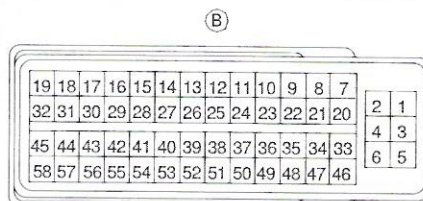
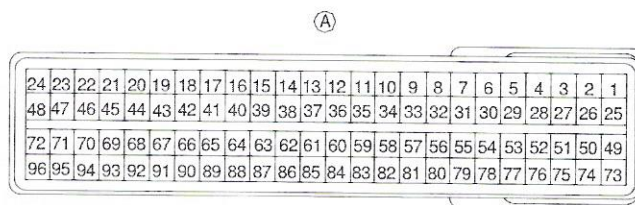
Pin#	Circuit and Status	Voltage
A1	Fuel Injector #3 No Specifications Available	N/A
A2	Fuel Injector #2 No Specifications Available	N/A
A6	Exhaust Gas Recirculation Valve Position Sensor Supply Ignition ON	4.8 to 5.2 Volts
A9	Fuel Pressure Sensor Supply Ignition ON	4.8 to 5.2 Volts
A10	Exhaust Gas Recirculation Valve Position Sensor Ground All Times	Low Volts
A11	Boost Sensor Ground All Times	Low Volts
A14	Camshaft Position Sensor Ground All Times	Low Volts
A15	Fuel Temperature Sensor Signal Ignition ON Fuel Temperature 20°C Fuel Temperature 50°C Fuel Temperature 90°C	 3.5 Volts approx 2.2 Volts approx 0.9 Volts approx
A16	Exhaust Gas Recirculation Valve Position Sensor Signal Ignition ON Dependant Upon Valve Position	 0.54 to 4.34 Volts
A25	Fuel Injector #1 No Specifications Available	N/A
A26	Fuel Injector #4 No Specifications Available	N/A
A28	Air Conditioner Relay Compressor Not Operating Compressor Operating	 Battery Volts Low Volts
A29	Camshaft Position Sensor Supply Ignition ON	4.8 to 5.2 Volts
A33	Boost Sensor Supply Ignition ON	4.8 to 5.2 Volts
A35	Transfer Neutral Switch (With RFW) Ignition ON Switch Open Switch Closed	 Battery Volts Low Volts
A37	4x4 Indicator Switch (With RFW) Ignition ON Switch Open Switch Closed	 Battery Volts Low Volts
A40	Fuel Pressure Sensor Signal Dependant Upon Pressure	0.2 to 4.8 Volts
A41	Intake Air Temperature Sensor 1 Signal Ignition ON Air Temperature 20°C Air Temperature 50°C Air Temperature 90°C	 3.5 Volts approx 2.2 Volts approx 0.9 Volts approx
A49	Fuel Injector #2 No Specifications Available	N/A
A50	Fuel Injector #4 No Specifications Available	N/A
A52	Intake Shutter Solenoid Half Control Engine Running Solenoid Operating Solenoid Not Operating	 Low Volts Battery Volts
A54	Intake Air Temperature Sensor 2 Signal Ignition ON Air Temperature 20°C Air Temperature 50°C Air Temperature 90°C	 3.5 Volts approx 2.2 Volts approx 0.9 Volts approx

Pin#	Circuit and Status	Voltage
A55	Intake Shutter Solenoid Full Control Engine Running Solenoid Operating Solenoid Not Operating	 Low Volts Battery Volts
A56	Engine Coolant Temperature Sensor Ground All Times	Low Volts
A60	Camshaft Position Sensor Signal Engine Cranking or Running	Voltage Pulse
A61	Idle Switch Ignition ON Switch Closed Switch Open	 Low Volts Voltage
A67	Engine Coolant Temperature Sensor Signal Ignition ON Coolant Temperature 20°C Coolant Temperature 50°C Coolant Temperature 90°C	 3.5 Volts approx 2.2 Volts approx 0.9 Volts approx
A69	Mass Air Flow Meter No Specifications Available	N/A
A70	Fuel Temperature Sensor Ground All Times	Low Volts
A71	CAN Low Ignition ON	Serial Data
A73	Fuel Injector #3 No Specifications Available	N/A
A74	Fuel Injector #1 No Specifications Available	N/A
A76	Exhaust Gas Recirculation Solenoid Engine Running	Duty Cycle
A77	Exhaust Gas Recirculation Control Solenoid Engine Running	Duty Cycle
A78	Variable Boost Control Solenoid Engine Running	Duty Cycle
A79	Fuel Metering Valve Engine Running	Duty Cycle
A81	Variable Swirl Control Solenoid No Specifications Available	N/A
A82	Glow Plug Relay Control Glow Plugs OFF Glow Plugs ON	 Battery Volts Low Volts
A84	Vehicle Speed Sensor Ignition ON Vehicle Moving Slowly	 Voltage Pulse
A85	RFW Switch (With RFW) Ignition ON Switch Open Switch Closed	 Low Volts Battery Volts
A88	Intake Air Temperature Sensor 2 Ground All Times	Low Volts
A89	Boost Sensor Signal Dependant Upon Boost	0 to 5 Volts
A90	Mass Air Flow Meter No Specifications Available	N/A
A91	Fuel Pressure Sensor Ground All Times	Low Volts
A92	Crankshaft Position Sensor Signal Engine Cranking or Running	AC Voltage Pulse
A93	Crankshaft Position Sensor Signal Engine Cranking or Running	AC Voltage Pulse
A94	Crankshaft Position Sensor Ground All Times	Low Volts
A95	CAN High Ignition ON	Serial Data



Connector 'B'

Pin#	Circuit and Status	Voltage	Pin#	Circuit and Status	Voltage
B1	ECM Power Supply		B31	Diagnostic Connector FEN Terminal	
	Ignition OFF	Low Volts		No Specifications Available	N/A
	Ignition ON	Battery Volts	B32	4x4 Indicator Lamp	
B2	Ground			Ignition ON	
	All Times	Low Volts		Lamp OFF	Battery Volts
B3	ECM Power Supply			Lamp ON	Low Volts
	Ignition OFF	Low Volts	B33	Glow Indicator Lamp	
	Ignition ON	Battery Volts		Ignition ON	
B4	Ground			Lamp OFF	Battery Volts
	All Times	Low Volts		Lamp ON	Low Volts
B5	ECM Power Supply		B35	Ignition Feed	
	Ignition OFF	Low Volts		Ignition ON	Battery Volts
	Ignition ON	Battery Volts	B38	Brake Lamp Switch	
B6	Ground			Brake Pedal at Rest	Low Volts
	All Times	Low Volts		Brake Pedal Depressed	Battery Volts
B9	Accelerator Pedal Position Sensor Signal Monitor		B39	Air Conditioner Amplifier	
	Ignition ON			No Specifications Available	N/A
	Pedal at Idle Position	0.4 to 0.8 Volts	B40	Neutral Position Switch	
	Pedal at Wide Open Position	3.4 to 3.8 Volts		Ignition ON	
B12	Accelerator Pedal Position Sensor Ground			Transmission in Neutral	Low Volts
	All Times	Low Volts		Transmission in Any Gear	Battery Volts
B13	Accelerator Pedal Position Sensor Supply		B41	ATCP Module	
	Ignition ON	4.8 to 5.2 Volts		Bus Negative	Serial Data
B18	Ignition Feed		B42	ATCP Module	
	Ignition ON	Battery Volts		Bus Positive	Serial Data
B19	Main Relay Control		B44	Remote Free Wheel Indicator Lamp	
	Ignition OFF	Battery Volts		Ignition ON	
	Ignition ON	Low Volts		Lamp OFF	Battery Volts
B22	Accelerator Pedal Position Sensor Signal Main			Lamp ON	Low Volts
	Ignition ON		B53	Remote Free Wheel Lock Solenoid (With RFW)	
	Pedal at Idle Position	0.4 to 0.8 Volts		Ignition ON	
	Pedal at Wide Open Position	3.4 to 3.8 Volts		RFW Locked	Low Volts
B25	Ignition Feed (No Immobiliser)			RFW Free	Battery Volts
	Ignition ON	Battery Volts	B54	Remote Free Wheel Free Solenoid (With RFW)	
B26	Diagnostic Connector Test Enable			Ignition ON	
	Connector Not Jumped to Ground	Voltage		RFW Locked	Battery Volts
	Connector Jumped to Ground	Low Volts		RFW Free	Low Volts
B27	Glow Plug Monitor		B56	Malfunction Indicator Lamp	
	Glow Plugs OFF	Low Volts		Ignition ON	
	Glow Plugs ON	Battery Volts		Lamp OFF	Battery Volts
B28	Clutch Pedal Position Switch			Lamp ON	Low Volts
	Ignition ON		B58	RFW Main Switch (With RFW)	
	Clutch Pedal at Rest	Battery Volts		Ignition ON	
	Clutch Pedal Depressed	Low Volts		Switch Open	Battery Volts
B30	Immobiliser Related Information			Switch Closed	Low Volts
	No Specifications Available	N/A			

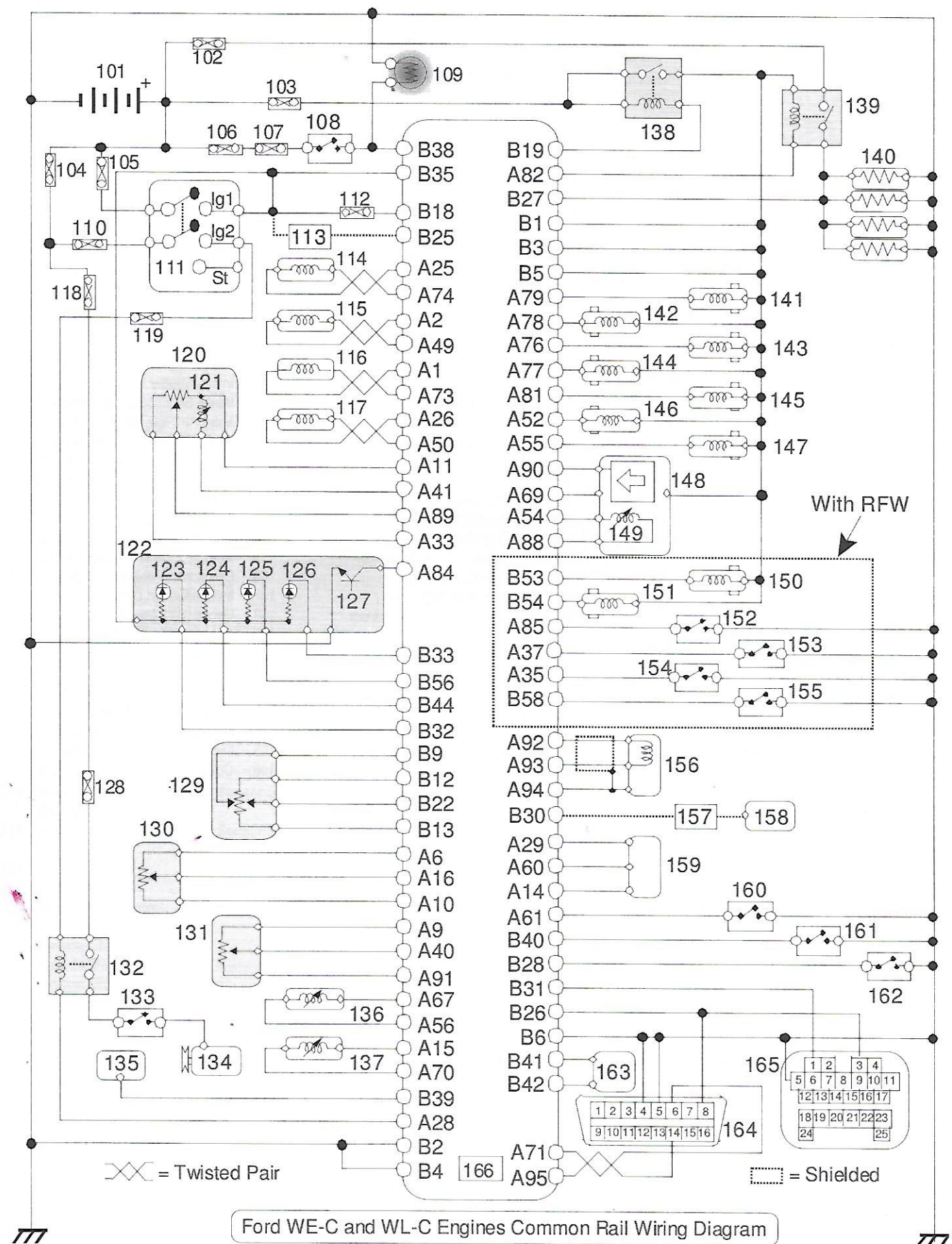


Ford / Mazda WL-C and WE-C Engines ECM Connectors
(Backprobing View)

Key To Wiring Diagram (next page)

- | | | |
|---------------------------------------|--|--------------------------------------|
| 101. Battery | 125. Malfunction Indicator Lamp | 145. Variable Swirl Control Solenoid |
| 102. Fuse Glow - 60 Amp | 126. Glow Plug Indicator Lamp | 146. Intake Shutter Solenoid Half |
| 103. Fuse Inj/Flp - 20 Amp | 127. Vehicle Speed Sensor | 147. Intake Shutter Solenoid Full |
| 104. Fuse Main - 80 Amp | 128. Fuse A/C - 10 Amp | 148. Mass Air Flow Meter |
| 105. Fuse Ig Key 1 - 40 Amp | 129. Accelerator Pedal Position Sensor | 149. Intake Air Temperature Sensor 2 |
| 106. Fuse Btn2 - 60 Amp | 130. Exhaust Gas Recirculation Valve Position Sensor | 150. Remote Free Wheel Lock Solenoid |
| 107. Fuse Stop - 15 Amp | 131. Fuel Pressure Sensor | 151. Remote Free Wheel Free Solenoid |
| 108. Brake Lamp Switch | 132. Air Conditioner Relay | 152. Remote Free Wheel Switch |
| 109. Brake Lamps | 133. Air Conditioner Refrigerant Low Pressure Switch | 153. 4x4 Indicator Switch |
| 110. Fuse Ig Key 2 - 60 Amp | 134. Air Conditioner Compressor | 154. Transfer Neutral Switch |
| 111. Ignition Switch | 135. Air Conditioner Amplifier | 155. Remote Free Wheel Main Switch |
| 112. Fuse Engine - 15 Amp | 136. Engine Coolant Temperature Sensor | 156. Crankshaft Position Sensor |
| 113. Circuit (No Immobiliser) | 137. Fuel Temperature Sensor | 157. Immobilisation Data |
| 114. Fuel Injector 1 | 138. Main Relay | 158. Circuit (With Immobiliser) |
| 115. Fuel Injector 2 | 139. Glow Plug Relay | 159. Camshaft Position Sensor |
| 116. Fuel Injector 3 | 140. Glow Plugs | 160. Idle Switch |
| 117. Fuel Injector 4 | 141. Fuel Metering Valve | 161. Neutral Switch |
| 118. Fuse Btn1 - 60 Amp | 142. Variable Boost Control Solenoid | 162. Clutch Pedal Position Switch |
| 119. Fuse A/C2 - 10 Amp | 143. Exhaust Gas Recirculation Solenoid | 163. ATCP Module (if fitted) |
| 120. Boost Pressure Sensor | 144. Exhaust Gas Recirculation Control Solenoid | 164. Diagnostic Connector (OBDII) |
| 121. Intake Air Temperature Sensor 1 | | 165. Diagnostic Connector 25 Pin |
| 122. Instrument Panel | | 166. Control Module (ECM) |
| 123. 4x4 Indicator Lamp | | |
| 124. Remote Free Wheel Indicator Lamp | | |

Wiring Diagram



Manufacturer: HOLDEN

Application: Captiva CG 2007-08
2.0L I4 Z20DTH CRD Engine

Subject: Engine Management System

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Transmission

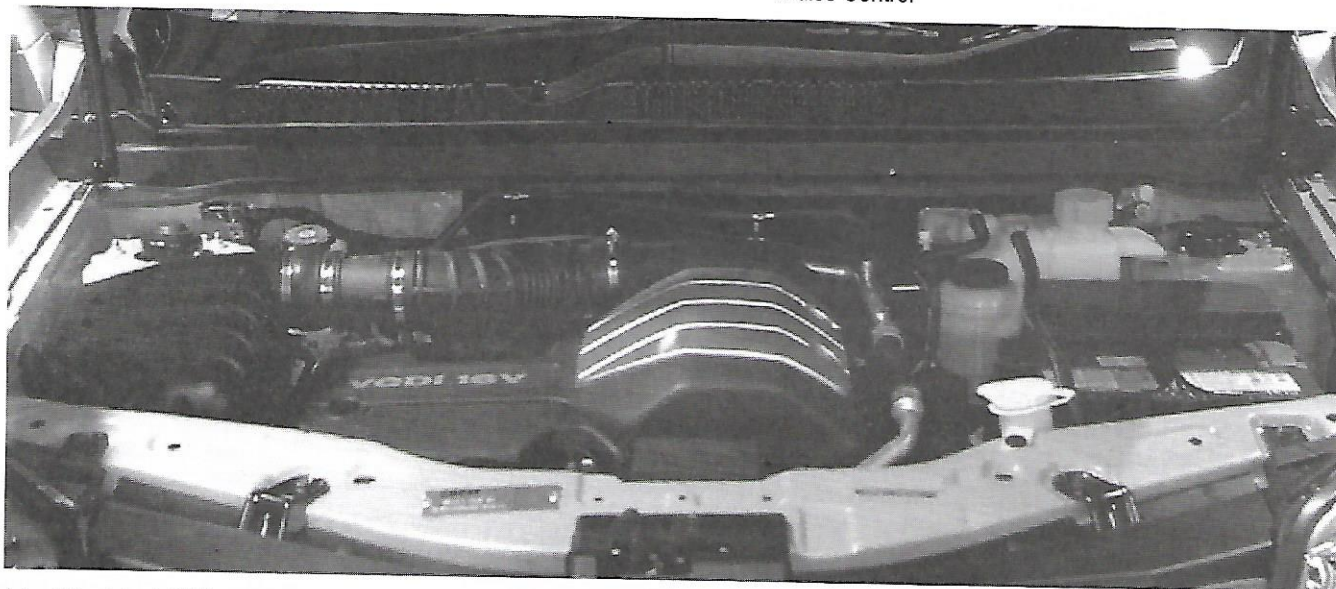
These vehicles may be fitted with a 5 Speed Manual or a 5 speed Aisin 55-51LE Auto Transmission.
All vehicles are fitted with an Active All Wheel Drive system.

Overview

These vehicles are fitted with a 2.0 Litre SOHC 16 valve direct injection I4 Common Rail Diesel engine.
The Fuel Injectors are operated sequentially and fuel is injected 3 or more times per cycle. Air mass calculation is by a Mass Air Flow Sensor. A Turbocharger and Intercooler are fitted.
Communication between modules is via serial data on either the CAN Communication Bus or the Low Speed GM LAN Serial Data Circuit. Gear driven twin balance shafts are located below the crankshaft.

The following are all electronically controlled:

- Glow Plug Control.
- Exhaust Gas Recirculation.
- Fuel Injector Operation.
- Fuel Pressure.
- Fuel Filter Heater.
- Throttle Actuator.
- Turbocharger Boost.
- A/C and Cooling Fans.
- Cruise Control



Control Module (ECM)

The two connector 154 pin ECM is located at the left rear of the engine. If the ECM is replaced, the following programming functions are required:

- ECM program.
- Injector Calibration Codes.
- Immobilisation System.
- Reset Diesel Particulate Filter system.
- Reset Engine Oil Life.

The factory Tech II scan tool is required for these functions.

Warning !

High voltages are used to operate the fuel injectors. Ensure ignition is OFF before touching or disconnecting any connectors.

Fault Codes

The Fault Codes are OBDII type. They can be accessed using a compatible scan tool.

Freeze Frame Data

If an emission related Fault Code logs, Freeze Frame Data provides a snap shot of conditions present and how the vehicle was driven at the time the Fault Code was logged. It can help isolate the cause of the Fault Code. An OBD II compatible scan tool is required to access this data.

Fault Code Extraction

Fault Codes can be extracted using a compatible scan tool.

Fault Code Erasure

Fault Codes can be erased using a compatible scan tool.

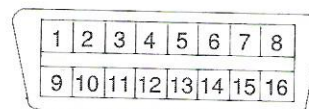
Note!

Switch OFF ignition and wait 10 seconds before running any Fault Code Extraction.

Diagnostic Connector

The 16 pin OBDII type Diagnostic Connector is located underneath the driver side dash.

A scan tool can be connected to this connector for diagnosis.



Diagnostic Connector

Fault Code Identification

Code #	Fault
P1011	Camshaft Position Sensor Fault
P1214	Throttle Position Sensor Self Test Out of Range
P1227	Fuel Injection Timing Solenoid Failed
P1233	Fuel Pump Driver Fault
P1447	Pre-catalyst Temperature Too High During Regeneration
P1629	Theft Deterrent Start Enable Signal Not Received
P1631	Theft Deterrent Start Enable Signal Not Correct
P1632	Theft Deterrent Start Disable Signal Received
P1668	Generator L-Terminal Control Fault
P2002	Particulate Trap Efficiency Below Threshold
P2031	Catalyst Temperature Sensor #2 Circuit or Sensor Fault
P2066	Fuel Level Sensor 2 Performance
P2067	Fuel Level Sensor 2 Circuit Low Voltage
P2068	Fuel Level Sensor 2 Circuit High Voltage
P2080	Catalyst Temperature Sensor Range/Performance
P2084	Catalyst Temperature Sensor Performance Sensor #2
P20E2	Catalyst Temperature Sensor Range/Performance
P2120	Accelerator Pedal Position (APP) Sensor 1
P2138	Accelerator Pedal Position (APP) Sensor 1 and 2 Signal Incorrect Ratio
P2146	Injector 1 or 4 Fault
P2149	Injector 2 or 3 Fault
P2227	Barometric Pressure (BARO) Sensor Performance

Code #	Fault
P2228	Barometric Pressure (BARO) Sensor Circuit Low Voltage
P2229	Barometric Pressure (BARO) Sensor Circuit High Voltage
P2264	Fuel Filter Water Level Sensing Sensor Self-test Signal Error
P2293	Rail Pressure Incorrect
P2294	Rail Pressure Control Solenoid Valve or Circuit Fault
P2299	Accelerator Pedal and Brake Plausibility Fault
P244B	Diesel Particulate Filter Differential Pressure Too High
P244C	Catalyst Temperature Too Low During Regeneration
P244D	Catalyst Temperature Too High During Regeneration
P2452	Diesel Particulate Filter Differential Pressure Sensor or Circuit Fault
P2453	Diesel Particulate Filter Differential Pressure Performance
P2454	Diesel Particulate Filter Fault
P2455	Diesel Particulate Filter Fault
P2463	Diesel Particulate Filter Soot Accumulation
P2500	Generator L-Terminal Circuit Low Voltage
P2501	Generator L-Terminal Circuit High Voltage
P2510	Main Relay Fault
P2533	Engine Control Module Relay Sense Circuit Range/Performance
P2544	Invalid Signal From Transmission Control Module
P2636	Mechanical Transfer Jet Pump; Fuel Level of Tank 1 Above the Upper Limit and Tank 2 Below the Lower Limit.
P2687	Fuel Filter Heater Fault
P268A	Injector Quantity Adjustment Not Programmed

Accelerator Control System

These vehicles use a fly by wire Accelerator Control System without a cable.

With this system, the ECM controls the fuel delivery based on driver demand from the Accelerator Pedal Position Sensor.

The system also controls idle speed and cruise control.

The system incorporates:

- Accelerator Pedal Position Sensor.
- ECM.
- Fuel Injectors.

Note!

The Throttle Actuator Motor and Throttle Valve are NOT used for acceleration control. Their function is to reduce engine shake on shut-down and assist in EGR control.

Accelerator Pedal Position Sensor

The dual potentiometer Accelerator Pedal Position Sensor is located at the accelerator pedal. The ECM monitors this sensor for driver demand.

It uses this signal along with its other inputs to determine the amount of engine fuel required.

To Test Voltage:

See ECM Pin #A8, A9, A30, A31, A45 and A46.

Air Conditioner Control System

These vehicles may be with either a Manual or an Automatic Air Conditioner Control System.

The Air Conditioner Control System consists of:

- A/C Control Module (Manual or Auto).
- A/C Refrigerant Pressure Sensor.
- Air Conditioner Cut Out Relay.
- ECM.

Air Conditioner Request Signal

The A/C Request Signal is created by operation of the:

- A/C Control Module ON Switch and Blower Switch (Manual A/C).
- A/C Control Module ON Switch (Auto A/C).

This signal is sent to the ECM via the Low Speed GM LAN Serial Data Circuit.

Air Conditioner Refrigerant Pressure Sensor

The A/C Refrigerant Pressure Sensor is located in the A/C high pressure pipe at the left front of the engine compartment. It creates a voltage signal based on refrigerant pressure. The ECM monitors the discharge pressure of the A/C system. It is used to interrupt system operation in the case of excessively high pressures.

To Test Voltage:

See ECM Pin #A12, A13 and A22.

Air Conditioner Cut Out Relay

The A/C Cut Out Relay is located in the Underhood Fuse and Relay Box at the left side of engine compartment. The ECM controls its operation.

To Test Voltage:

See ECM Pin #A29.

Automatic Transmission Control Module

The Automatic Transmission Control Module (TCM) is located under the dash on the driver's side. During gear shifts, the TCM may request the ECM reduce engine torque. This may be done by retarding timing. This provides smoother gear shifting. The torque reduction request is made via the CAN Communication Bus.

Barometric Air Pressure Sensor

The Barometric Air Pressure Sensor is incorporated within the ECM. Sensor operation can be checked with a compatible scan tool.

Note!

Ensure atmospheric vent in ECM housing is not blocked or contains moisture. Otherwise the sensor may be damaged or produce inaccurate readings.

Brake Lamp Switch

The Brake Lamp Switch is located at the pedal cluster. The ECM monitors this switch for brake pedal application.

To Test Voltage:

See ECM Pin #A17.

Body Control Module

The Body Control Module (BCM) is located centrally in the dash panel behind the radio. The BCM acts as a gateway between the High Speed CAN Communication Bus and the Low Speed GM LAN Serial Data Circuit. The BCM shares information between the two networks.

Systems communicating direct to the BCM include the:

- Ignition Switch.
- Cruise Control.
- Immobiliser Module.

Starter Motor Operation

The BCM receives signals from the ignition Switch that indicate the driver requests such as switching ON the ignition or requesting cranking of the engine.

Operating modes are:

- OFF.
- Accessory.
- ON.
- Crank.

This information is then shared with other modules via the CAN or GM LAN communication networks. When the ECM detects the request to start from the BCM, it will operate the Starter Motor Relay.

Camshaft Position Sensor

The Camshaft Position Sensor is located on the valve cover at the rear of the engine. It is a Hall Effect sensor. The ECM monitors this sensor for camshaft position.

To Test Voltage:

See ECM Pin #B20 and B50.

Note!

Check with an oscilloscope for square wave pattern and frequency changing with engine speed.

Charging System

The ECM controls alternator output through a signal to the internal voltage regulator. The Alternator is located at the left front of the engine.

To Test Voltage:

See ECM Pin #A75 and A79.

Alternator Warning Lamp

The Alternator Warning Lamp is located in the Instrument cluster. It is a battery symbol. Its operation is controlled by the ECM. Requests are conveyed from the ECM via the Low Speed GM LAN Serial Data Circuit.

Clutch Pedal Position Switch (Manual)

The Clutch Pedal Position Switch is located at the pedal cluster. It is a normally open switch. When depressed, it is used by the ECM to:

- Enable engine cranking.
- Disable the cruise mode.

To Test Voltage:

See ECM Pin #A80.

Crankshaft Position Sensor

The Crankshaft Position Sensor is located at the lower right side of the engine block at the rear. It is a variable reluctance type sensor. The signal plate is attached to crankshaft web adjacent to cylinder #4. It has 58 reluctor teeth with a missing tooth to identify #1 TDC. The ECM uses this signal to determine engine speed and crankshaft position.

To Test Voltage:

See ECM Pin #B7, B12 and B27.

To Test Resistance:

Disconnect connector and measure between terminals :
Should be 700 to 1200 Ohms @ 20° C.

Note!

Check with an oscilloscope for AC wave pattern and frequency changing with engine speed.

Cruise Control System

The Cruise Control function is carried out internally by the ECM. The Cruise Control system consists of:

- Cruise Control Steering Wheel Switches.
- Clockspring.
- Cruise Control Brake Pedal Switch.
- Clutch Pedal Position Switch (Manual).
- Body Control Module.
- Cruise Control Indicator Lamp.
- ECM.

The ECM controls cruise operation through the quantity of fuel injected.

Cruise Control Steering Wheel Switches

The Cruise Control Steering Wheel Switches are located on the steering wheel.

Each switch produces a different voltage level signal to request a cruise function from the ECM. The ECM monitors these inputs for cruise demand. They are momentary contact switches connected through the clockspring to the Body Control Module (BCM). From the BCM the signals are sent to the ECM via the High Speed CAN Communication Bus.

Cruise Control Brake Pedal Switch

The Cruise Control Brake Pedal Switch is located at the pedal cluster.

This is a normally closed switch that communicates its status direct to the Body Control Module. From the BCM its signal is sent to the ECM via the High Speed CAN Communication Bus. The ECM monitors this switch status for brake pedal application to cut out the cruise mode.

Body Control Module

The Body Control Module receives most of the inputs for the Cruise Control System.

It communicates the status of these inputs to the ECM via the High Speed CAN Communication Bus.

Cruise Control Indicator Lamp

The Cruise Control Indicator Lamp is located in the Instrument Cluster. It is switched by the BCM.

The ECM will request it is illuminated via the CAN Communication Bus.

Current Drain

Current Drain is the current that continues to flow to various memory circuits on the vehicle; including the ECM, after the Ignition is switched OFF.

Maximum Current Drain should be less than 50 mA (0.05 Amps) with no electrical load (Ignition and all accessories OFF).

Note!

Wait 30 minutes for all modules to switch OFF. After market accessories and alarms may increase the Current Drain.

Diesel Particulate Filter System

The Diesel Particulate Filter (DPF) System is used to manage the emission of Particulate Matter (soot).

Particulate Matter is the result of incomplete diesel combustion. The DPF is used for storage of Particulate Matter produced. To remove Particulate Matter, the DPF Active Regeneration process is performed.

This process is controlled by the ECM based on monitored parameters.

The DPF System includes:

- Oxidation Catalytic Converter (increases exhaust temp during regeneration).
- Diesel Particulate Filter (DPF).
- Exhaust Differential Pressure (DP) Sensor.
- Exhaust Gas Temperature Sensors #1 and #2.
- Three Warning Lamps.
- ECM with Restricted Power Mode strategy.

Note!

After replacing DPF System components, inspect the ECM for related learning values to be initialised. These functions are performed using the factory Tech II scan tool.

Diesel Particulate Filter

The Diesel Particulate Filter (DPF) is located in the exhaust system after the catalytic converter.

Externally it looks similar to a catalytic converter.

It has a smaller front section that contains an additional catalytic converter. Its function is to collect particulate matter from the exhaust gases.

It regularly regenerates by burning off the accumulated particulate matter.

Exhaust Differential Pressure Sensor

The Exhaust Differential Pressure Sensor is located centrally at the front of the engine. It is a Piezo resistive element type sensor. It is connected to the inlet and outlet sides of the DPF by separate pressure sensing hoses.

The sensor measures the difference in exhaust pressure before and after the DPF. It sends a voltage signal to the ECM indicating the exhaust pressure drop across the DPF. It is used by the ECM to determine the blockage status of the DPF and to schedule Active Regeneration.

To Test Voltage:

See ECM Pin #A37, A44 and A64.

To Test Pressure Drop:

At Idle, there should be from 0 to 10 kPa pressure drop across the DPF.

Exhaust Gas Temperature Sensors

These vehicles use two Exhaust Gas Temperature Sensors.

- Exhaust Gas Temp Sensor #1 - downstream of the catalytic converter, before the DPF.
- Exhaust Gas Temp Sensor #2 - mid area of the DPF.

These sensors have a positive temperature co-efficient.

The ECM monitors these Sensor signals primarily during the DPF regeneration process.

To Test Voltage:

See ECM Pin #A32, A33, A34 and A35.

To Test Resistance:

Disconnect connector and measure between terminals: Should be 220 Ohms approx @ 25° C.

Warning Lamps

There are 3 lamps that indicate various DPF actions or requirements needed:

- DPF Regeneration Active Lamp.
- Glow Indicator Lamp.
- Service Vehicle Soon Lamp.

DPF Regeneration Lamp

The DPF Regeneration Lamp is located in the Instrument Cluster. It is controlled by the ECM via the Low Speed GM LAN Serial Data Circuit.

The ECM will illuminate this Lamp whenever an Active Regeneration is in process.

The vehicle should continue to be driven until the lamp switches OFF.

Driving should be > 50 km/h for approx. 15 minutes.

Glow Indicator Lamp

The Glow Indicator Lamp is located in the Instrument Cluster.

As well as indicating Glow Plug operation, the Glow Indicator Lamp is also used by the DPF System.

If the ECM determines that an Active Regeneration is required, but current vehicle driving does not support the necessary conditions, the Glow Lamp will flash. This indicates to the driver to keep driving.

Driving should be > 50 km/h for approx. 15 minutes.

Service Vehicle Soon Lamp

The Service Vehicle Soon Lamp is located in the Instrument Cluster. It contains a vehicle symbol and a spanner.

If driving conditions have not been suitable to support an Active Regeneration (i.e. the Glow Indicator Lamp has been flashing for some time), the ECM will:

- Illuminate the Service Vehicle Soon Lamp.
- Log a Fault Code.
- Initiate Power Reduction Mode.

Reduced power minimises potential damage to the DPF and makes it obvious to the driver that a repair is necessary.

When this lamp is illuminated, a Service Regeneration MUST be conducted. DO NOT keep driving.

Note!

This lamp may also illuminate if TCM Fault Codes are logged.

Diesel Particulate Filter Active Regeneration

This regeneration process is used to burn off accumulated particulate matter within the DPF.

The accumulation amount is calculated by the ECM based on monitored parameters. If this calculation exceeds set parameters, the ECM determines that regeneration is required.

DPF Active Regeneration will be conducted by the ECM when;

- Coolant temperature is between 80° C and 110° C.
- Vehicle speed is >50 km/h.
- Amount of accumulated particulate matter exceeds specified value.

Note!

If regeneration is required the ECM will flash the Glow Indicator Lamp. This encourages the driver to continue driving under the right conditions to enable Active Regeneration.

Active Regeneration Process

During DPF Active Regeneration, the exhaust temp is artificially increased to 600°C approx. This is achieved using ECM controls affecting fuel, timing, intake air and turbocharger operation.

The stored Particulate Matter is then burnt from the DPF, during this high temperature phase.

Feedback of the regeneration process is provided by various ECM sensors.

The DPF Regeneration Lamp will remain illuminated during this process.

Should any of the DPF regeneration requirements no longer be met, the Active Regeneration process will cease.

Note!

An interrupted regeneration process may contribute to increasing the engine oil dilution amount. Engine oil dilution results from the ECM use of post-injections as part of catalyst activation.

Diesel Particulate Filter Service Regeneration

If ECM attempts to conduct an Active Regeneration are continually interrupted, the Particulate Matter amount will continue to increase.

Should this occur then the ECM may illuminate the Service Vehicle Soon Lamp and initiate Power Reduction Mode.

As a result a Service Regeneration will be required, using the factory Tech II scan tool.

Prior to conducting a Service Regeneration, ensure:

- DPF System is operating normally - no Fault Codes logged.
- Engine is at normal operating temp (80°C to 90°C).
- All accessories and loads are OFF.
- Bonnet is open.

The vehicle must be on a level surface, outdoors, away from combustible materials.

Follow scan tool procedure. After conducting a Service Regeneration, allow the engine to cool down slowly.

Run the engine at 1500 RPM for approx. 1 minute.

Note!

Ensure the exhaust is free of any combustible debris before conducting a Service Regeneration.

Engine Oil Dilution

Whenever a Service Regeneration is conducted, the engine oil will be diluted by excess fuel.

The oil should be changed if:

- It is past 80% of the oil change interval.
- 3 Service Regenerations are run back to back.

Note!

After replacing the engine oil, the ECM engine oil learning value needs to be reset. This function is performed using the factory Tech II scan tool.

Exhaust Gas Recirculation System

The ECM controls the volume of exhaust gas recirculated to suit all conditions through the Exhaust Gas Recirculation (EGR) Control Valve.

This reduces combustion temperatures and lowers exhaust NO_x emissions.

The system incorporates:

- EGR Solenoid.
- EGR Control Valve.
- EGR Cooler.
- Mass Air Flow Sensor.
- ECM.

EGR Solenoid

The EGR Solenoid is located at the rear of the engine.

The ECM actuates this solenoid to control EGR Control Valve operation.

To Test Voltage:

See ECM Pin #B60.

EGR Control Valve

The Exhaust Gas Recirculation (EGR) Valve is located at the right rear of the engine.

It is vacuum controlled via the EGR Solenoid.

Mass Air Flow Sensor

The ECM uses the change in MAF sensor signal to determine the rate of EGR flow.

Engine Coolant Temperature Sensor

The Engine Coolant Temperature Sensor is located at the front of the intake manifold adjacent to the coolant outlet.

The resistance of this thermistor decreases as temperature rises.

The ECM monitors this sensor to determine the engine coolant temperature. It is also used by the ECM to control Engine Cooling Fan operation.

To Test Voltage:

See ECM Pin #A18 and A66.

To Test Resistance:

Disconnect connector and measure between terminals.

Temperature	Resistance
20°C	2.5 k Ohms
40°C	1.2 k Ohms
80°C	0.329 k Ohms

Engine Cooling Fan Control System

The Engine Cooling Fan Control System consists of:

- Main Cooling Fan.
- Auxiliary Cooling Fan.
- 3 Cooling Fan Relays.
- ECM.

Cooling Fans

These vehicles are fitted with 2 electric cooling fans.

The electric fans are located at the radiator shroud.

The ECM controls operation of the Cooling Fans via the Cooling Fan Relays.

Cooling Fan Relays

The three Cooling Fan Relays are located in the Underhood Fuse and Relay Box at the left side of engine compartment.

The relays are:

- Cooling Fan Main Relay.
- Cooling Fan Control Relay.
- Cooling Fan Auxiliary Relay.

To Test Voltage:

See ECM Pin #A69 and A90.

Engine Low Oil Pressure Switch

The Engine Low Oil Pressure Switch is located on the right side of the engine block at the oil filter housing.

The switch closes when oil pressure is below 50 kPa.

Low oil pressure status is conveyed from the ECM to the Instrument Cluster via the Low Speed GM LAN Serial Data Circuit.

To Test Voltage:

See ECM Pin #B35.

Electronic Stability Program

These vehicles are fitted with an Electronic Stability Program (ESP) System.

Vehicle stability is maintained by controlling engine torque and or applying brake pressure to individual wheels.

The ESP System ECM is located at the left side of the engine compartment. It is integrated with the ABS Modulator.

It incorporates:

- Anti-lock Braking System.
- Electronic Brake-force Distribution.
- Vehicle Dynamic Control Module.
- Hill Descent Control System.

The Engine ECM monitors the various ESP ECM requests for traction and stability control demand. This is carried out via the High Speed CAN Communication Bus.

Based on information received, the ECM may control engine output.

In certain situations it helps correct understeer or oversteer.

Fuel Filter Assembly

The Fuel Filter Assembly is located at the right rear of the engine compartment.

It combines the:

- Water Separator.
- Water-in-Fuel Warning Lamp Sensor.
- Fuel Heater Element.
- Fuel Temperature Sensor.
- Fuel Filter Element.

Water-in-Fuel Warning Lamp Sensor

The Water-in-Fuel Warning Lamp Sensor is located in the base of the Fuel Filter. It signals the ECM if water accumulation is excessive.

To Test Voltage:

See ECM Pin #A58.

Water-in-Fuel Warning Lamp

The Water-in-Fuel Warning Lamp is located on the Instrument Cluster. A request to illuminate the Lamp is communicated from the ECM to the Instrument Cluster via the High Speed CAN Communication Bus.

Note!

If the Water-in-Fuel Warning Lamp is illuminated, the water must be drained immediately to ensure the injector pump is not damaged by water.

Fuel Filter Heater and Temperature Sensor

A Fuel Heater Element is installed at the fuel inlet to the filter.

It incorporates the Fuel Temperature Sensor. These form part of the filter housing cap.

This assists in cold running in extreme climates. The heating element is controlled by the Fuel Filter Heater Relay.

To Test Voltage:

See ECM Pin #A10 and A11.

Fuel Filter Heater Relay

The Fuel Heater Relay is located in the Auxiliary Fuse Box at front of engine compartment. It controls operation of the Fuel Filter Heater.

To Test Voltage:

See ECM Pin #A68.

To Test Resistance:

Disconnect connector and measure across relay windings:

Should be 70 to 110 Ohms @ 20° C.

Draining Water Separator

Water is drained from a tap at the base of the filter.

Bleed the Fuel system after draining the filter.

Fuel Filter Bleeding

The fuel supply system will require bleeding if the:

- Engine has run out of fuel.
- Fuel filter has been replaced.
- Fuel lines or pump were disconnected.
- Fuel filter drain was opened while the engine was running.

Bleeding Procedure:

1. Switch ignition ON for 5 seconds.
2. Switch ignition OFF for 3 seconds.
3. Repeat Steps 1 to 2 a further 6 or 7 times.

Note!

A compatible scan tool can also be used to conduct bleeding. Do not start engine until bleeding process is completed.

Fuel Filter Replacement

Special tools are required to safely dismantle the fuel filter housing.

Fuel Injectors

The Fuel Injectors are located in the cylinder head.

They are operated sequentially through an injector driver unit integrated in the ECM.

Should an injector be replaced, its Fuel Injector Calibration Code must be input into the ECM.

Warning!!

The Injectors operate at approx. 140 volts with around 7 Amps of current flow. Switch ignition OFF before removing Injector connectors.

Do not remove injector harness connectors when the engine is running.

To Test Voltage:

See ECM pin #B1, B2, B16, B17, B31, B33, B46 and B47.

To Test Resistance:

Disconnect connector and measure across terminals:

Should be 0.3 to 0.6 Ohms @ 20° C.

Fuel Injector Calibration Code

The Fuel Injector Calibration Code is a seven digit alphanumeric code printed on the head of each injector. During manufacture each injector is calibrated into a particular grade.

Should an injector be replaced, the new injector's calibration code must be input into the ECM.

Should the ECM be replaced, all of the existing calibration codes must be input into the new ECM.

A compatible scan tool is required to conduct this procedure.

If an incorrect code is input into the ECM;

- The engine may rattle.
- Engine idle may become rough.
- Engine life may be shortened.

Fuel Injector Balance

The ECM has the ability to vary the fuel injected into each cylinder to provide a smooth idle.

The ECM monitors the amount of fuel required to balance each cylinder.

A Fault Code will log if this is excessive:

- Check engine condition and compressions.
- Fuel supply and pump.

Fuel Injector Pipes

The high pressure Fuel Injector Pipes are single use only.

They must NOT be reused.

To ensure correct sealing, they must be replaced with new pipes if loosened or removed. Take extra care to ensure dirt is kept out of open fuel line connectors.

Warning!!

Due to extremely high fuel pressures, the fuel pipes must not be loosened while the engine is running.

Fuel Injection Timing

Fuel Injection Timing is ECM controlled and is not adjustable.

Multiple injections occur during various driving modes:

- Pre Injection (reduces combustion noise and emissions).
- Main Injection.
- Post Injection/s.
-

Fuel Injector Pump

The mechanical Fuel Injector Pump is located at the lower left side of the engine. It is belt driven from the crankshaft.

The Fuel Pump contains:

- High Pressure Pump Elements.
- Fuel Injector Pump Metering Valve.

Pressurised fuel is supplied by the Pump to the Common Fuel Rail and from there to each Fuel Injector.

Fuel supply to the Pump is ECM controlled by the Fuel Injector Pump Metering Valve.

The Fuel Injector Pump is not timed to the engine.

Fuel Injector Pump Metering Valve

The Fuel Injector Pump Metering Valve is located at the rear of the Fuel Injector Pump.

The ECM controls low pressure fuel supply to the Pump inlet through the Fuel Injector Pump Metering Valve.

It is a normally open valve.

Excess fuel is returned to the fuel tank.

To Test Voltage:

See ECM Pin #B19 and B49.

To Test Resistance:

Disconnect connector and measure across terminals:

Should be 2 to 4 Ohms @ 20° C.

Fuel Pressure

Fuel Pressure is regulated at the Common Fuel Rail by the ECM via the Fuel Rail Pressure Control Valve. During normal operation it runs up to 165,000 KPa (24,000 PSI). Fuel Rail Pressure is read only from a compatible scan tool.

Note!

Ensure Fuel Rail pressure has dissipated before working on the fuel system. This may take several minutes after the engine is switched OFF.

Common Fuel Rail

The Common Fuel Rail is located on the left side of the engine. It contains the:

- Fuel Pressure Sensor.
- Fuel Rail Pressure Control Valve.

Fuel Pressure Sensor

The Fuel Pressure Sensor (Piezo electric element) is located at the front of the Common Fuel Rail.

The ECM monitors this sensor to determine the fuel pressure. This sensor can be replaced separately from the Common Fuel Rail.

To Test Voltage:

See ECM Pin #B8, B28 and B43.

Fuel Rail Pressure Control Valve

The Fuel Rail Pressure Control Valve is located at the rear of the Common Fuel Rail. It controls fuel pressure in the Common Fuel Rail. It is a normally closed valve.

Excess fuel is returned to the fuel tank. This valve can be replaced separately from the Common Fuel Rail.

To Test Voltage:

See ECM Pin #B4 and B34.

To Test Resistance:

Disconnect connector and measure across terminals:

Should be 4 to 6 Ohms @ 20° C.

Fuel Tank

The Fuel Tank is a divided unit with two interconnected reservoirs due to the driveshaft configuration.

The Fuel Tank contains the Primary and Secondary Fuel Pump Modules. The Fuel Pump Modules are accessed below the rear seat.

The Primary Fuel Pump Module is on the right side and contains the:

- Fuel Lift Pump.
- Fuel Outlet and Return.
- Primary Fuel Level Sensor.

The Secondary Fuel Pump Module is on the left side and contains the:

- Siphon Jet Pump.
- Secondary Fuel Level Sensor.

Primary Fuel Pump Module

Fuel Lift Pump

The electric Fuel Lift Pump supplies fuel pressure to the Fuel Injector Pump via the Fuel Filter and lines.

An inlet strainer is fitted to the Pump.

Fuel Lift Pump Relay

The Fuel Lift Pump Relay is located in the Underhood Fuse and Relay Box at the left side of engine compartment.

It is energised for approx. 2 seconds when the ignition is switched ON.

To Test Voltage:

See ECM Pin #A20.

To Test Resistance @ 20 C:

Disconnect connector and measure across relay windings:

Should be 70 to 110 Ohms @ 20° C.

Fuel Lift Pump Pressure

With the Ignition ON, fuel pressure from the lift pump should be 414 to 483 kPa.

Cycle the key a few times or use compatible scan tool to run pump and read the pressure.

Alternatively, a gauge can be installed in the feed line from the Fuel Filter to the Fuel Injector Pump.

Secondary Fuel Pump Module

Siphon Jet Pump

Fuel is continually transferred from the left side of the tank to the right side by the Siphon Jet Pump via an internal transfer tube.

Fuel Level Sensors

The Fuel Level Sensor signals are communicated direct to the ECM. The ECM monitors the signal from each of the fuel level sensors to determine fuel level.

The fuel level signal is then sent from ECM to Instrument Cluster via the Low Speed GM LAN Serial Data Circuit.

To Test Voltage (Primary Level Sensor):

See ECM Pin #A14 and A15.

To Test Voltage (Secondary Level Sensor):

See ECM Pin #B41 and B58.

To Test Resistance @ 20° C:

Disconnect connector and measure across terminals:

Float Position	Resistance
Empty	40 Ohms approx.
Full	250 Ohms approx.

Fuse Locations

The following fuses are located in the Underhood Fuse and Relay Box at the left side of engine compartment.

Fuse EF2 – 60 Amp

Fuse EF3 – 40 Amp

Fuse EF5 – 20 Amp

Fuse EF7 – 40 Amp

Fuse EF8 – 30 Amp

Fuse EF9 – 30 Amp

Fuse EF10 – 20 Amp

Fuse EF11 – 15 Amp

Fuse EF12 – 15 Amp

Fuse EF13 – 10 Amp

Fuse EF14 – 10 Amp

Fuse EF15 – 15 Amp

Fuse EF17 – 20 Amp

Fuse EF20 – 15 Amp

The following fuses are located in the Auxiliary Fuse Box at front of engine compartment.

Fuse AF1 – 60 Amp
 Fuse AF2 – 30 Amp
 Fuse AF3 – 40 Amp
 Fuse AF4 – 40 Amp
 Fuse AF5 – 40 Amp

The following fuses are located in the Instrument Panel Fuse Box.

Fuse 9 – 10 Amp
 Fuse 12 – 2 Amp
 Fuse 18 – 10 Amp
 Fuse 19 – 15 Amp
 Fuse 27 – 15 Amp
 Fuse 28 – 15 Amp

Glow Control System

The Glow Control System consists of the:

- Glow Control Module.
- Glow Plugs.
- Glow Indicator Lamp.
- ECM.

Glow Plug Control Module

The Glow Plug Control Module is located at the left front of the engine compartment.

The ECM controls Glow Plug operation via this module.

To Test Voltage - See ECM Pin #A52 and A93.

Glow Plugs

The Glow Plugs are located in the cylinder head.

The ECM controls operation of the Glow Plugs through the Glow Plug Control Module.

Glow Operation:

- Ignition ON - glow time based on coolant temperature.
- Cranking - glow ON.
- Running - "after glow" time based on coolant temperature.
-

To Test Resistance:

Disconnect connector and measure across terminals:

Should be 1 to 2.5 Ohms @ 20° C.

Glow Indicator Lamp

The Glow Indicator Lamp is located in the Instrument Cluster.

The ECM commands this lamp ON when the Glow Plugs are operating.

It is controlled via the Low Speed GM LAN Serial Data Circuit.

Note!

The Glow Indicator Lamp will flash if more driving is required to enable a Diesel Particulate Filter Regeneration.

Idle Speed (Base)

Base Idle Speed is ECM controlled and is NOT adjustable.

The ECM controls the idle speed for all conditions through fuel injector delivery.

The Idle Speed setting is not specified in the factory workshop manual.

Immobilisation System

The Immobilisation System electronically immobilises the engine if attempts are made to "hot wire" or use an invalid ignition key.

The system consists of:

- Ignition Key Transponder.
- Ignition Lock Transceiver.
- Immobiliser Module.
- Body Control Module.
- Anti Theft Lamp.
- ECM.

The system is disarmed if a correctly coded key is used to switch the ignition ON.

Note!

The Immobilisation System is independent of the remote keyless entry system.

Ignition Key Transponder

The Ignition Key incorporates a Transponder.

The Transponder contains a unique electronic identification code. It communicates with the Ignition Lock Transceiver when the ignition is switched ON.

The key's ID must be trained to the system before it can start the vehicle.

Note!

Avoid interference from excessive keys and metallic objects on the same ring as the Ignition Key.

Ignition Lock Transceiver

The Ignition Lock Transceiver is located at the ignition switch. It receives Transponder code information when the ignition is switched ON.

The Transceiver is incorporated with the Immobiliser Module.

Immobiliser Module

The Immobiliser Module is located at the ignition switch.

Note!

If the Immobiliser Module is replaced, it must first be configured using the factory Tech 2 scan tool. Then the keys must be trained to the module.

Anti Theft Lamp

The Anti Theft Lamp is located on the Instrument Cluster.

As a visual deterrent, the Lamp flashes every few seconds.

It is switched by the Immobiliser Module via the Body Control Module.

If there is a fault with the Immobilisation System, the Anti Theft Lamp will flash.

Immobilisation System operation:

1. The Ignition Lock Transceiver receives a signal from the Ignition Key when it is turned to start.
2. The Immobiliser Module verifies that the Ignition Key Transponder is valid.
3. It compares this data with values stored in the Immobiliser Module and the ECM.
4. If a match is made, the Immobiliser Module will request the ECM to mobilise the engine.
5. If the response is incorrect, the Immobiliser Module will request the ECM to immobilise the engine.

This request is made via the Low Speed GM LAN Serial Data Circuit.

Immobilised State

If a faulty or invalid key is used to start:

- The Immobiliser Module does not respond to the ECM, as it cannot validate the transponder code.
- If the code does not match, the engine is immobilised by the ECM.
- The Anti Theft Lamp remains ON.

Ignition Key Training

Adding new Ignition Key Transponders can be done without the factory scan tool if an existing trained key is on hand.

1. Switch ON the ignition with an existing trained key.
2. Switch the ignition OFF.
3. Within 4 seconds, insert a new key.
4. Switch the ignition ON with the new key.
5. The new key is trained.
6. Repeat the procedure to train additional keys.

A maximum of 10 Ignition Key Transponders can be trained to the vehicle.

Note!

Module Configuration and deleting keys can only be done with the factory Tech II scan tool.

Instrument Cluster

The hybrid type Instrument Cluster operates using both hard wire and Serial Communication.

The Instrument Cluster incorporates:

- Instrument Cluster ECU
- Malfunction Indicator Lamp (MIL)
- Anti Theft Lamp
- Water-in-Fuel Warning Lamp
- Alternator Warning Lamp
- Engine Low Oil Pressure Warning Lamp
- Cruise Control Indicator Lamp
- DPF Regeneration Active Lamp.
- Glow Indicator Lamp.
- Service Vehicle Soon Lamp.

Instrument Cluster ECM

The Instrument Cluster ECM is located in the Instrument Cluster. It receives information and requests to carry out actions via the Low Speed GM LAN Serial Data Circuit.

Main Relay

The Main Relay is located in the Underhood Fuse and Relay Box at the left side of engine compartment.

It is used to provide power to the ECM and related sensors and actuators.

To Test Voltage:

See ECM Pin #A1, A3, A5 and A72.

To Test Resistance:

Disconnect connector and measure across relay windings: Should be 70 to 110 Ohms @ 20° C.

Mass Air Flow Sensor

The Mass Air Flow Sensor is located in the air duct adjacent to the air filter housing.

It incorporates the Intake Air Temperature Sensor.

The ECM monitors this sensor to determine the quantity and speed of intake air.

It is also used to provide feedback to the ECM during EGR operation.

To Test Voltage:

See ECM Pin #B37, B42 and B44.

Intake Air Temperature Sensor

The Intake Air Temperature Sensor is located within the Mass Air Flow Sensor. The ECM monitors this sensor to determine intake air temperature.

To Test Voltage:

See ECM Pin #B37 and B44.

To Test Resistance:

Remove connector and measure across terminals:

Temperature	Resistance
20°C	2.5 k Ohms
40°C	1.2 k Ohms
80°C	0.329 k Ohms

Park / Neutral Position Switch (Auto)

The Park / Neutral Position Switch is located on top of the auto transmission housing. It is combined with the Auto Trans Range Switch. It allows the engine to start only when the Auto Trans is in Park or Neutral positions.

To Test Voltage:

See ECM Pin #A81.

PTC Heater System (If Fitted)

The PTC Heater System consists of the:

- Run Relay.
- PTC Relays #1 to #3.
- PTC Heater.
- HVAC PTC Request.

Run Relay

The Run Relay is located in the Underhood Fuse and Relay Box at the left side of engine compartment. It supplies battery power to the PTC Relay windings.

Its operation is controlled by the Body Control Module.

PTC Relays

The three PTC Relays are located in the Auxiliary Fuse Box at front of engine compartment.

To Test Voltage – See ECM Pin #A91 and A94.

PTC Heater

The PTC Heater is located under the console.

HVAC PTC Request

The Air Conditioner Control System produces the PTC request signal. This is hard wired direct to the ECM.

To Test Voltage:

See ECM Pin #A57.

Run And Crank Relay

The Run And Crank Relay is located in the Instrument Panel Fuse Box. Its operation is controlled by the Body Control Module. It provides battery power to the:

- ECM.
- Fuel Level Sensors.
- Clutch Pedal Position Switch.

To Test Voltage:

See ECM Pin #A28.

Reverse Lamp Switch (Manual)

The Reverse Lamp Switch is located in the right rear corner of the manual transaxle.

To Test Voltage:

See ECM Pin #A40.

Serial Communication

These vehicles use two separate communication networks:

- The High Speed CAN Communication Bus (or High Speed GM LAN).
- The Low Speed GM LAN Serial Data Circuit.

Both networks are used for various engine management functions. The Body Control Module forms a gateway between the High Speed CAN and the Low Speed GM LAN Serial Data Circuit.

High Speed CAN Communication Bus

These vehicles use BUS Communication (Bi-Directional Universal Signal). The Bus consists of a twisted pair wiring to minimise external interference. The protocol used is Controller Area Network (CAN).

This is a high speed Class C network with a low travel time (Latency). Low latency is critical for powertrain control and vehicle dynamics.

Each module in the CAN Bus is a "node" and sends and receives messages. The "Terminating Nodes" are inside the ECM and the Body Control Module (BCM). The terminating nodes contain 120 ohm resistors across each Bus wire to prevent corruption of signals.

The High Speed CAN Communication Bus links the:

- ECM.
- ABS / ESP Module.
- Body Control Module.
- Transmission Control Module (If Fitted).
- Diagnostic Connector.
- All Wheel Drive Control Module.

These modules are connected in a "daisy chain" configuration. If one module is disconnected it will affect other modules.

To Test Voltage – See ECM Pin #A83 and A84.

Low Speed GM LAN Serial Data Circuit

The single wire Low Speed GM LAN Serial Data Circuit links the:

- ECM.
- A/C Control Unit.
- Diagnostic Connector.
- Instrument Cluster.
- Body Control Module.
- Immobiliser Module.
- Air Bag Control Module.
- Audio System.
- Driver Information System (If Fitted).

To Test Voltage:

See ECM Pin #A43.

Note!

If there is a break or short in the CAN network, some modules will not be able to communicate with each other. If the CAN Bus is shorted together, to power or to ground, then all communication will cease.

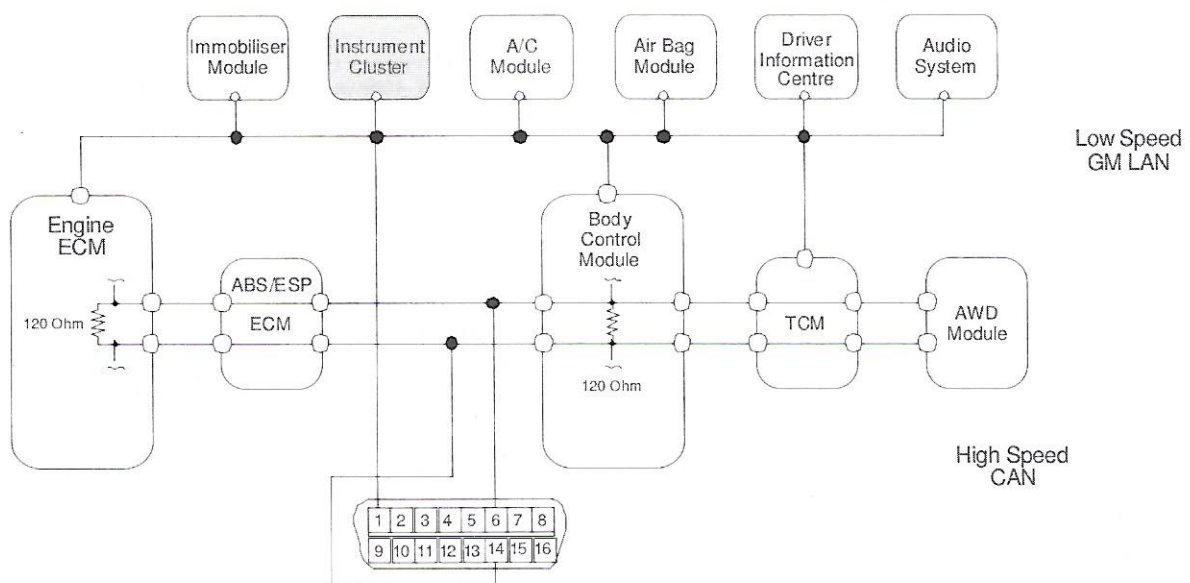
Testing High Speed CAN Communication Bus

The CAN end bus 120 Ohm resistors are located in the ECM and the Body Control Module.

To Test Resistance:

Disconnect battery ground terminal, measure across Diagnostic Connector terminals #6 and #14:

Should be 60 Ohms approx.



Holden Captiva Z20DTH 2.0L CR Diesel Communication Networks

Starter Motor Relay

The Starter Motor Relay is located in the Underhood Fuse and Relay Box at the left side of engine compartment. It is used to control the inhibitor operation of the starter motor.

To Test Voltage:
See ECM Pin #A55.

Throttle Body

The electronic Throttle Body is located on the inlet manifold. It incorporates the:

- Throttle Actuator Motor.
- Throttle Valve.
- Throttle Position Sensor.

Throttle Actuator Motor

Throttle Actuator Motor is integrated with the Throttle Body. The Actuator Motor is driven to a target position by the ECM using current control. The throttle valve is then moved to the desired position. Feedback of throttle valve position is provided by the Throttle Position Sensor. During normal operating conditions the throttle valve is fully open.

The ECM will close the throttle valve during:

- EGR Valve operation (variable closure angle).
- DPF Regeneration (variable closure angle).
- Engine shut down for a few seconds.

When the engine is switched OFF, it cuts off all air supply eliminating engine run on.

To Test Voltage:
See ECM Pin #B52 and B59.

Throttle Position Sensor

The Throttle Position Sensor is located within the Throttle Body. It provides the ECM with feedback on the Throttle Valve position.

To Test Voltage:
See ECM Pin #B59.

Turbocharger System

The Turbocharger System incorporates:

- Variable Vane Turbocharger.
- Turbocharger Intercooler.
- Turbocharger Boost Control System.

Turbocharger

The Variable Vane Turbocharger is located on the right side of the engine. Boost pressure is ECM controlled by changing the angle of the turbine feed vanes.

Turbocharger Intercooler

The Turbocharger Intercooler is located on top of the radiator. The incoming air is compressed by the Turbocharger causing it to become heated. This air is then cooled by the Intercooler to give greater volumetric efficiency.

Note!

Ensure all turbocharger hose connections are clean and secure to avoid blow off.

Turbocharger Boost Control System

The Turbocharger Boost Control System consists of:

- Turbocharger Boost Control Actuator.
- Turbocharger Boost Pressure Sensor.

Turbocharger Boost Control Actuator

The Turbocharger Boost Control Actuator is located at the Turbocharger. It is operated by the ECM. It varies the angle of the turbine feed vanes.

To Test Voltage:
See ECM Pin #B15.

Turbocharger Boost Pressure Sensor

The Turbocharger Boost Pressure Sensor is located on top of the intake manifold adjacent to the Throttle Body. It incorporates the Manifold Air Temperature Sensor. The ECM monitors this sensor for engine load values and Turbocharger boost pressure.

To Test Voltage:
See ECM Pin #B13, B23 and B40.

Manifold Air Temperature Sensor

The Manifold Air Temperature Sensor is located in the Turbocharger Boost Pressure Sensor. The ECM monitors this sensor to determine intake air temperature.

To Test Voltage:
See ECM Pin #B13 and B53.

Vacuum Pump

The Vacuum Pump is located at the rear of the cylinder head. It is driven by the back of the camshaft. It provides vacuum for various actuators:

- EGR Solenoid.
- Brake Booster.
-

Vehicle Speed Sensor (VSS)

The Vehicle Speed Sensor is located on top of the transaxle housing at the rear. The Vehicle Speed Signal is communicated to the ECM via the High Speed CAN Communication Bus.

Warning Lamps

Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) is located in the Instrument Cluster. It illuminates for engine and emission related faults. The Instrument Cluster ECU activates this Lamp. ECM requests are sent via the Low Speed GM LAN Serial Data Circuit.

Service Vehicle Soon Lamp

The Service Vehicle Soon (SVS) Lamp is located in the Instrument Cluster. It has a vehicle and spanner icon. It illuminates for:

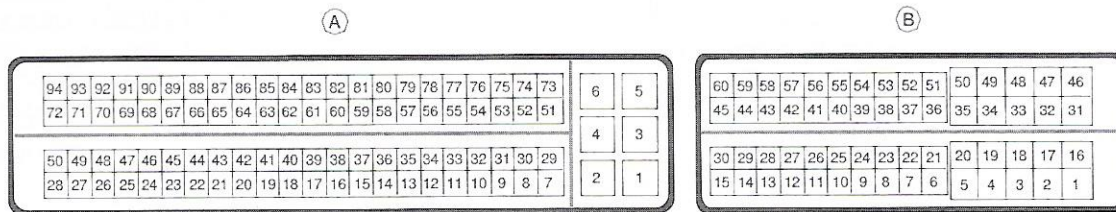
- Automatic Transmission faults.
- Diesel Particulate Filter System faults.

The Instrument Cluster ECU activates this Lamp. ECM requests are sent via the Low Speed GM LAN Serial Data Circuit.

Note!

Should the MIL or SVS illuminate (continuous or flashing), this indicates a system fault.
Check ECM for the presence of Fault Codes.

ECM Voltage Table



Holden Captiva Z20DTH 2.0L CR Diesel ECM Connectors (Back Probing View)

Warning!

High voltages are used to operate the fuel injectors.
Ensure ignition is OFF before touching or disconnecting injector wiring.

Connector 'A'

Pin#	Circuit and Status	Voltage
A1	ECM Power Supply Ignition ON	Battery Volts
A2	ECM Ground All Times	0 Volts
A3	ECM Power Supply Ignition ON	Battery Volts
A4	ECM Ground All Times	0 Volts
A5	ECM Power Supply Ignition ON	Battery Volts
A6	ECM Ground All Times	0 Volts
A8	Accelerator Pedal Position Sensor #2 Ground All Times	0 Volts
A9	Accelerator Pedal Position Sensor #1 Signal Ignition ON Accelerator Pedal Released Accelerator Pedal Fully Depressed	0.9 to 1.2 Volts > 4.0 Volts
A10	Fuel Filter Heater Temperature Sensor Ground All Times	0 Volts
A11	Fuel Filter Heater Temperature Sensor Signal No Specifications Available	N/A
A12	A/C Refrigerant Pressure Sensor Ground All Times	0 Volts
A13	A/C Refrigerant Pressure Sensor Signal Ignition ON Dependant on Refrigerant Pressure	0.1 to 4.9 Volts
A14	Primary Fuel Level Sensor Ground All Times	0 Volts
A15	Primary Fuel Level Sensor Signal No Specifications Available	N/A
A17	Brake Lamp Switch Ignition ON Brake Pedal Released Brake Pedal Depressed	0 Volts Battery Volts
A18	Engine Coolant Temperature Sensor Ground All Times	0 Volts
A20	Fuel Pump Relay Control Ignition ON Fuel Pump OFF Fuel Pump ON	0 Volts Battery Volts
A22	A/C Refrigerant Pressure Sensor 5 Volt Power Supply Ignition ON	5 Volts
A25	Audio System Communication Line (If Fitted) No Specifications Available	N/A
A28	ECM Power Supply Ignition ON	Battery Volts

Pin#	Circuit and Status	Voltage
A29	Air Conditioner Relay Ignition ON A/C Compressor Clutch OFF A/C Compressor Clutch ON	Battery Volts Low Volts
A30	Accelerator Pedal Position Sensor #1 Ground All Times	0 Volts
A31	Accelerator Pedal Position Sensor #2 Signal Ignition ON Accelerator Pedal Released Accelerator Pedal Fully Depressed	0.45 to 0.62 Volts > 2.0 Volts
A32	Exhaust Gas Downstream Temperature Sensor Signal No Specifications Available	N/A
A33	Exhaust Gas Downstream Temperature Sensor Ground All Times	0 Volts
A34	Exhaust Gas Upstream Temperature Sensor Signal No Specifications Available	N/A
A35	Exhaust Gas Upstream Temperature Sensor Ground All Times	0 Volts
A37	Exhaust Differential Pressure Sensor Ground All Times	0 Volts
A40	Reverse Position Switch (Manual) Ignition ON Reverse Gear Selected Any Other Gear Selected	Low Volts High Volts
A43	Low Speed GM LAN Serial Data Circuit No Specifications Available	N/A
A44	Exhaust Differential Pressure Sensor 5 Volt Power Supply Ignition ON	5 Volts
A45	Accelerator Pedal Position Sensor #1 5 Volt Power Supply Ignition ON	5 Volts
A46	Accelerator Pedal Position Sensor #2 5 Volt Power Supply Ignition ON	5 Volts
A52	Glow Plug Control Module No Specifications Available	N/A
A55	Starter Motor Relay Control Ignition ON Relay OFF Relay ON - Cranking	Low Volts Battery Volts
A57	A/C PTC Request (If Fitted) No Specifications Available	N/A
A58	Water In Fuel Sensor Signal No Specifications Available	N/A
A64	Exhaust Differential Pressure Sensor Signal Ignition ON	0.45 to 0.55 Volts

Pin#	Circuit and Status	Voltage	Pin#	Circuit and Status	Voltage
A66	Engine Coolant Temperature Sensor		A83	Serial Communication (CAN High)	
	No Specifications Available	N/A		Ignition ON	
A68	Fuel Filter Heater Relay Control			Data Idle State	2.5 Volts Approx.
	Ignition ON			During Data Transmission	Serial Data
	Relay OFF	Battery Volts	A84	Serial Communication (CAN Low)	
	Relay ON	Low Volts		Ignition ON	
A69	Auxiliary Cooling Fan Relay Control			Data Idle State	2.5 Volts Approx.
	Ignition ON			During Data Transmission	Serial Data
	Relay OFF	Battery Volts	A86	ATCP Module (If Fitted)	
	Relay ON	Low Volts		BUS Line Positive	Data Stream
A72	Main Relay Control		A90	Main Cooling Fan Relay Control	
	Ignition ON			Ignition ON	
	Relay OFF	Battery Volts		Relay OFF	Battery Volts
	Relay ON	Low Volts		Relay ON	Low Volts
A75	Alternator Field Signal		A91	PTC Relay #2 And #3 Control (If Fitted)	
	No Specifications Available	N/A		Ignition ON	
A79	Alternator Charge Indicator Control			Relay OFF	Battery Volts
	No Specifications Available	N/A		Relay ON	Low Volts
A80	Clutch Pedal Position Switch		A92	ATCP Module (If Fitted)	
	Ignition ON			BUS Line Negative	Data Stream
	Clutch Pedal Released	Low Volts	A93	Glow Plug Control Module	
	Clutch Pedal Depressed	Battery Volts		No Specifications Available	N/A
A81	Park / Neutral Position Switch (Auto)		A94	PTC Relay #1 Control (If Fitted)	
	Ignition ON			Ignition ON	
	Park or Neutral Selected	Low Volts		Relay OFF	Battery Volts
	Any Other Gear Selected	High Volts		Relay ON	Low Volts

(A)

(B)

94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73
72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51
50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29
28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7

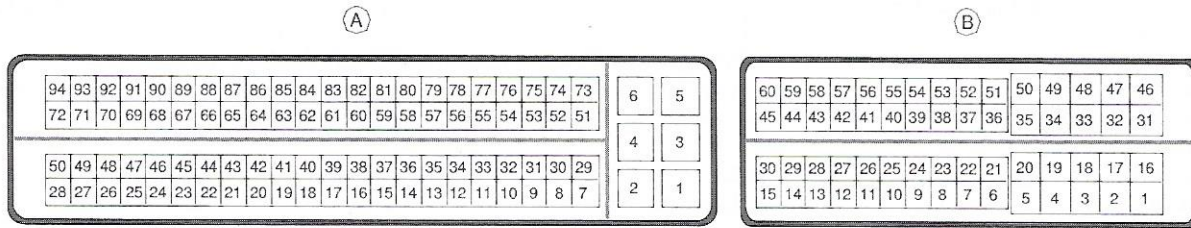
60	59	58	57	56	55	54	53	52	51	50	49	48	47	46
45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Holden Captiva Z20DTH 2.0L CR Diesel ECM Connectors (Back Probing View)

Connector 'B'

Pin#	Circuit and Status	Voltage	Pin#	Circuit and Status	Voltage
B1	Fuel Injector #3 High		B28	Fuel Rail Pressure Sensor 5 Volt Power Supply	
	Engine Idling	Battery Volts		Ignition ON	5 Volts
B2	Fuel Injector #2 High		B31	Fuel Injector #2 Low	
	Engine Idling	Battery Volts		No Specifications Available	N/A
B4	Fuel Rail Pressure Control Valve		B33	Fuel Injector #4 Low	
	No Specifications Available	N/A		No Specifications Available	N/A
B7	Crankshaft Position Sensor Shield Ground		B34	Fuel Rail Pressure Control Valve	
	All Times	0 Volts		No Specifications Available	N/A
B8	Fuel Rail Pressure Sensor Ground		B35	Engine Low Oil Pressure Switch	
	All Times	0 Volts		Ignition ON	
B12	Crankshaft Position Sensor Signal			Low or No Oil Pressure - Switch Closed	Low Volts
	Ignition ON			Normal Oil Pressure - Switch Open	High Volts
	Engine Cranking	> 1.3 Volts AC	B37	Intake Air Temperature Sensor	
	Engine Running	AC Voltage Pulse		No Specifications Available	N/A
B13	Turbocharger Boost Pressure Sensor 5 Volt Power Supply		B40	Turbocharger Boost Pressure Sensor Signal	
	Ignition ON	5 Volts		No Specifications Available	N/A
B15	Turbocharger Boost Control Actuator		B41	Secondary Fuel Level Sensor Ground	
	No Specifications Available	N/A		All Times	0 Volts
B16	Fuel Injector #1 High		B42	Mass Air Flow Sensor Signal	
	Engine Idling	Battery Volts		No Specifications Available	N/A
B17	Fuel Injector #4 High		B43	Fuel Rail Pressure Sensor Signal	
	Engine Idling	Battery Volts		No Specifications Available	N/A
B19	Fuel Injector Pump Metering Valve		B44	Mass Air Flow Sensor Ground	
	No Specifications Available	N/A		All Times	0 Volts
B20	Camshaft Position Sensor Ground		B46	Fuel Injector #3 Low	
	All Times	0 Volts		No Specifications Available	N/A
B23	Turbocharger Boost Pressure Sensor Ground		B47	Fuel Injector #1 Low	
	All Times	0 Volts		No Specifications Available	N/A
B27	Crankshaft Position Sensor Signal		B49	Fuel Injector Pump Metering Valve	
	Ignition ON			No Specifications Available	N/A
	Engine Cranking	> 1.3 Volts AC	B50	Camshaft Position Sensor Signal	
	Engine Running	AC Voltage Pulse		Engine Cranking or Running	Voltage Pulse

Pin#	Circuit and Status	Voltage	Pin#	Circuit and Status	Voltage
B52	Electronic Throttle Actuator Control		B59	Throttle Position Sensor	
	No Specifications Available	N/A		No Specifications Available	N/A
B53	Manifold Air Temperature Sensor Signal		B60	EGR Solenoid	
	No Specifications Available	N/A		Engine Running	
B58	Secondary Fuel Level Sensor Signal			During EGR Operation	Duty Cycle Signal
	No Specifications Available	N/A			



Holden Captiva Z20DTH 2.0L CR Diesel ECM Connectors (Back Probing View)

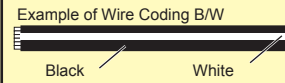
Key To Wiring Diagram (next page)

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> 101. Battery 102. Fuse EF5 – 20 Amp 103. Starter Motor Relay 104. Starter Motor 105. Fuse EF2 – 60 Amp 106. Fuse F12 – 2 Amp 107. Engine Coolant Temperature Sensor 108. Ignition Key Immobilisation Transponder 109. Ignition Switch 110. ATCP Module (If Fitted) 111. Immobiliser Module and Transceiver Antenna 112. Body Control Module 113. Engine Low Oil Pressure Switch 114. High Speed CAN Communication Network Modules 115. ABS / ESP Module 116. Fuse F19 – 15 Amp 117. Diagnostic Connector 118. Fuse F28 – 15 Amp 119. Instrument Cluster ECM 120. Anti Theft Lamp 121. Instrument Cluster 122. Malfunction Indicator Lamp 123. Service Vehicle Soon Lamp 124. Glow Indicator Lamp 125. DPF Regeneration Lamp 126. Water-In-Fuel Warning Lamp 127. Low Speed GM LAN Serial Data Modules 128. Alternator 129. Fuse EF7 – 40 Amp 130. Fuse F27 – 15 Amp 131. Run And Crank Relay 132. Water-In-Fuel Warning Lamp Sensor | <ul style="list-style-type: none"> 133. Fuse F9 – 10 Amp 134. Mass Air Flow Sensor 135. Primary Fuel Level Sensor 136. Secondary Fuel Level Sensor 137. Clutch Pedal Position Switch (Manual) 138. Run Relay 139. Fuse EF3 – 40 Amp 140. Fuse F18 – 10 Amp 141. PTC Relay #1 (If Fitted) 142. Fuse AF3 – 40 Amp 143. Fuse AF4 – 40 Amp 144. PTC Relay #2 (If Fitted) 145. Fuse AF5 – 40 Amp 146. PTC Relay #3 (If Fitted) 147. PTC Heater (If Fitted) 148. Fuse EF20 – 15 Amp 149. Brake Lamp Switch 150. Air Conditioner Control Module 151. Brake Lamps Circuit 152. Accelerator Pedal Position Sensor 153. Exhaust Differential Pressure Sensor 154. Upstream Exhaust Gas Temperature Sensor 155. Downstream Exhaust Gas Temperature Sensor 156. Fuse EF13 – 10 Amp 157. Main Relay 158. Fuse EF17 – 20 Amp 159. Fuel Lift Pump Relay 160. Fuse EF10 – 20 Amp 161. Fuse EF12 – 15 Amp 162. Camshaft Position Sensor 163. Fuse EF11 – 15 Amp 164. Fuel Lift Pump 165. Throttle Actuator Motor and Throttle Position Sensor | <ul style="list-style-type: none"> 166. Turbocharger Boost Control Actuator 167. Fuse EF15 – 15 Amp 168. EGR Solenoid 169. Fuel Filter Heater Relay 170. Fuse AF2 – 30 Amp 171. Fuel Filter Heater Element 172. Fuel Heater Temperature Sensor 173. Glow Control Module 174. Fuse AF1 – 60 Amp 175. Glow Plugs 176. Air Conditioner Cut Out Relay 177. Fuse EF14 – 10 Amp 178. Audio System Communication (If Fitted) 179. Air Conditioner Compressor 180. Fuse EF9 – 30 Amp 181. Fuse EF8 – 30 Amp 182. Cooling Fan Main Relay 183. Cooling Fan Auxiliary Relay 184. Cooling Fan Control Relay 185. Engine Main Cooling Fan 186. Engine Auxiliary Cooling Fan 187. Fuel Injectors 188. Fuel Injector Pump Metering Valve 189. Fuel Rail Pressure Control Valve 190. Fuel Pressure Sensor 191. Reverse Lamp Switch (Manual) 192. Park / Neutral Position Switch (Auto) 193. Crankshaft Position Sensor 194. Air Conditioner Refrigerant Pressure Sensor 195. Manifold Air Temperature Sensor 196. Turbocharger Boost Pressure Sensor 197. Electronic Control Module |
|--|---|---|

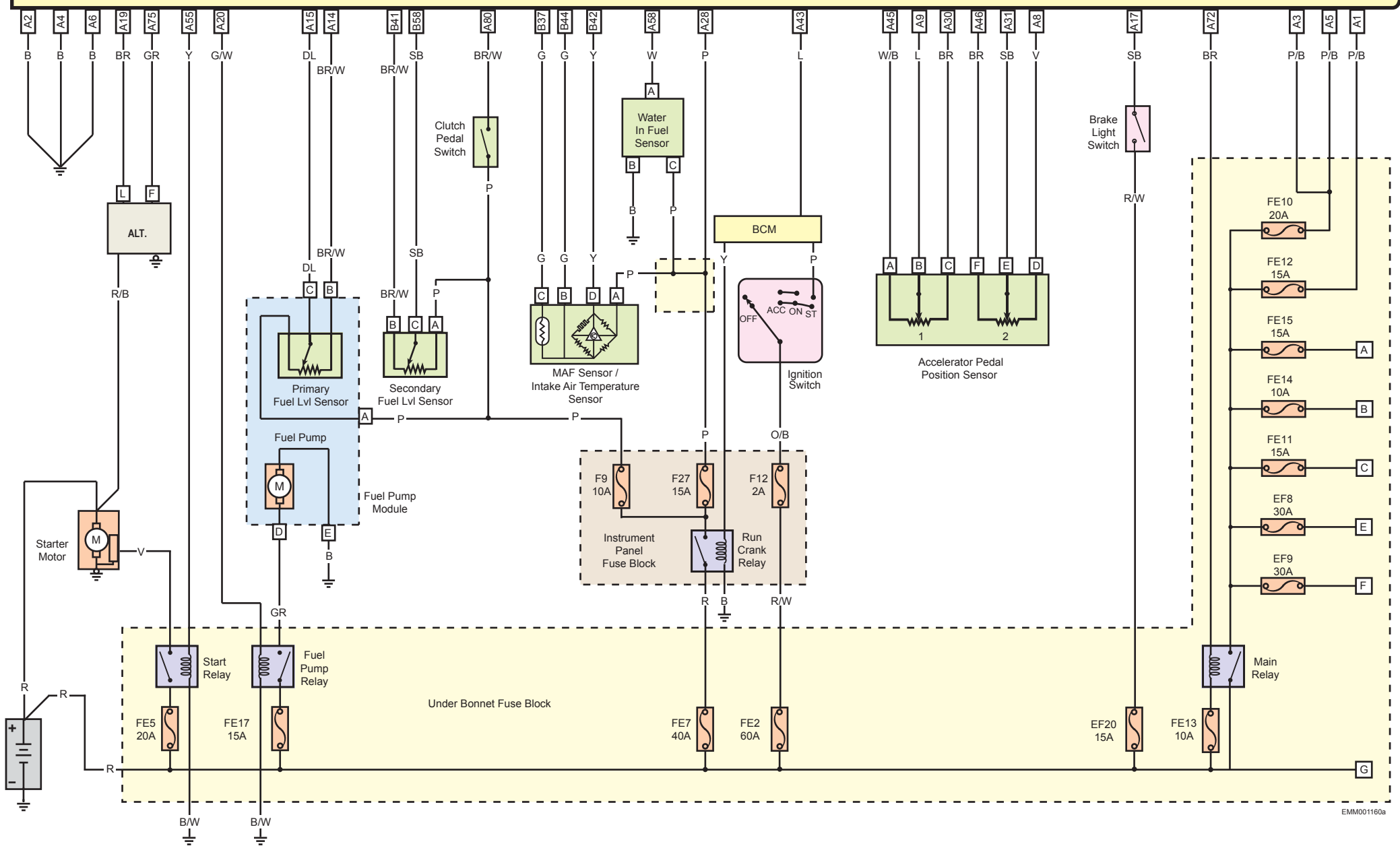
HOLDEN CG Captiva 2.0L Turbo Diesel 2007 – 2010

Engine Management Wiring Diagram Page 1 of 3

Wire Colour Legend



Black - B	Blue - L	Red - R	White - W
Brown - BR	Light Green - LG	Sky Blue - SB	Yellow - Y
Green - G	Orange - O	Dark Blue - DL	
Gray - GR	Pink - P	Violet - V	



HOLDEN CG Captiva 2.0L Turbo Diesel 2007 – 2010

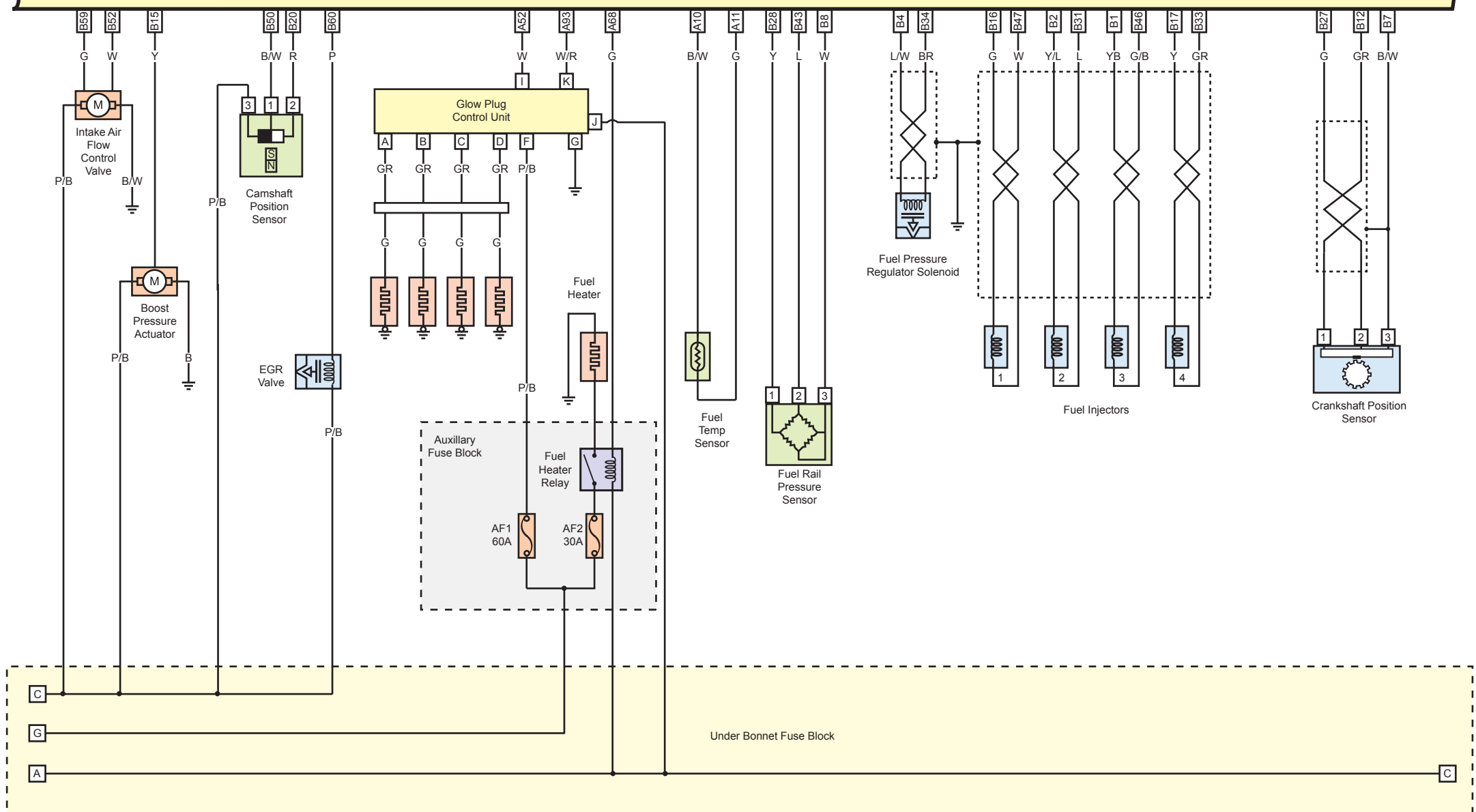
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Wire Colour Legend

Example of Wire Coding B/W



Black - B	Blue - L	Red - R	White - W
Brown - BR	Light Green - LG	Sky Blue - SB	Yellow - Y
Green - G	Orange - O	Dark Blue - DL	
Gray - GR	Pink - P	Violet - V	



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Engine Management Wiring Diagram Page 3 of 3

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